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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION

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Forthcoming Event

JUNE 5-8.

Institute of British Foundrymen.—Annual Conference in Manchester.

The Philadelphia Congress

The programme of the Fifth International Foundry Congress, which is to be held in Philadelphia during the week of October 22, is being rapidly completed. The names of the contributors of the Exchange Papers are becoming available, and the first to be announced is that of Dr. W. H. Hatfield, who is to present a thesis on behalf of the Institute of British Foundrymen, whilst Prof. Piwowarsky is to prepare a Paper on behalf of Germany. Those British foundrymen, who are considering the advisability of participation, are balancing the cost with the prospects of worth-while information. With this there is no implied desire to see a direct profit resulting from the time spent out of Britain, but rather as to whether a study of American conditions as they exist to-day would be helpful in the general revamping of ideas for the better conduct of their own business. We have just been studying most carefully the last copy of the Transactions of the American Foundrymen's Association, and from it we have realised that the intense depression recently experienced in the New World has gone far to align their problems with those existing here. No longer can the American foundry executive plan for almost unlimited production, and he must now impose upon his organisation that factor of elasticity which has always been of such paramount importance on this side of the Atlantic. There is a realisation that over-mechanisation is possible, and unprofitable.

Academic research has progressed. The American standard is now equal to the best in Europe. Moreover, it has expanded and many more workers are now engaged in the field of foundry research work. In the past, American work has largely been of two kinds, the one presented a mass of figures with few conclusions of worth, and the other presented statements of opinion not adequately reinforced by data. Obviously, from a huge continent there were many brilliant exceptions, such as Bolton, MacPherran, MacKenzie, Clamer, Saeger, Coyle, Anderson and Schwartz, whose works are appreciated the world over. The research work on foundry sands was originated in America, and the work of Ries and Dietert and their collaborators is everywhere appreciated; sand-testing as an aid to control is a moneymaking proposition still insufficiently appreciated in Europe. This is matter specially to be noted by intending visitors. The Americans, on their part, will be anxious to get European opinion on the progress registered on this side with the pulverised-fuel-fired rotary furnaces, recent attempts at mechanisation, educational activities, and so forth. At no time has a visit to the States been of greater interest, because of the distinct narrowing of the gap separating the major activities of the two countries. Britain now knows quite a good deal about mechanisation, while America is well informed on the academic side. America has advanced far with the use of electric furnaces in the iron foundry and Britain with pulverised fuel and oil. Thoughts on testing are running in parallel channels. Recruitment and training of moulding staff, the provision of educational facilities for future executives are problems requiring solution on both sides of the Atlantic. The labour turnover problem is becoming less important in America, but the return of so many men, after long spells of idleness in Britain has introduced analogous difficulties. The methods instituted for industrial recovery in the United States associated with the closer alignment of European and American foundry problems make participation in the Philadelphia Congress of truly outstanding worth.

North and South

Two interesting points have been made public during the week, not having any necessary connection with each other but both bearing on industrial production. The Board of Trade made a survey of industrial development for 1933 and reported that during that period 463 new factories were opened. Of this figure sixty-five represented transfers from other areas, but only in three cases could it be said that the works concerned were taking part in a drift from north to south. In two of these there were technical reasons for the change. Thus under analysis the so-called southern drift disappears. It would be of great interest to know whether it ever really had any substance, and, if so, whether it has finished or whether one or two isolated cases became magnified. If any such movement is over it is a compliment to the industrial resilience of the north because, if a firm is tempted to move, naturally the question of inducements to remain arises. The new factories employ about 30,000 people. The number of factories closed during the year was 409. Of the new factories opened 37 were established by or with the aid of foreign firms, mainly German and American.

The other important point is the considered refusal of the Engineering Employers' Federation of a forty-hour working week, put forward by the trades unions to absorb 10 per cent. of unemployed labour. The E.E.F. point out that the 47-hour week has been in operation for 15 years. There is no evidence that this reduction from 54 hours had any effect in increasing employment. On the contrary, the country has since 1919 suffered severely in competition on account of higher wages and shorter hours than other countries. They point out that British engineering rests on quality and craftsmanship, and hours of labour are of more importance than under a mass-production condition. With these sentiments we think most people will agree. If the change could be brought about internationally, or indeed nationally, there would be something to be said, but it is difficult to see how it can be done piecemeal; or if there were any proposal to maintain the same hourly rates on the shorter schedule, it would not upset the competitive balance. As it is, an increase in costs would be inevitable.

Difficult Tin Situation

By "ONLOOKER."

One uncertainty in the tin situation has been removed by the action of the International Tin Committee in deciding to increase quotas by 10 per cent., this alteration to take place as from April 1 last and to last for six months until the end of September, during which period production will be added to by some 9,000 tons. The first effect upon the market of this news was to bring about a sharp fall of nearly £5, but following this the quotation steadied and no big reaction is anticipated, for during the past few months the average monthly reduction in visible supplies has exceeded 1,500 tons.

That the decision to increase the rate of production was overdue cannot be doubted, for stocks in this country have fallen to a dangerously low level, and the presence of a backwardation of more than £3 shows that the situation is quite abnormal. As a result of this heavy premium for the cash position, hedging by making sales of three months' tin has virtually ceased, so that consumers and producers are left without a form of protection to which they have every right, and of which in these difficult times they very frequently have need. This is more particularly the case since by common consent the price of tin is unduly high and is already leading to dangerous developments in the shape of increasing production by properties not in the international agreement.

Before the recent announcement of an increase was made it was anticipated that of the 10 per cent. addition, one-half would be allocated to a reserve stock to be held by the Tin Pool. It now appears that if and when the Buffer Pool is accepted a further increase of 10 per cent. will be arranged, and that this tonnage will be held off the market as a buffer between between the consumers and the wicked speculator! Somehow or other the users of tin remain unconvinced of the benefits of the Buffer Pool, and not unnaturally the merchants are also up against it. Restriction of output was doubtless necessary to get tin out of the rut, but it should never have been employed to lift it on to a pinnacle!

It has, of course, been evident for a long time past that the machinations of the International Tin Committee are distrusted by many of the producers, and since the Buffer Pool scheme savours very much of financial manipulation, it is liked even less than the earlier schemes of those in control of the situation. Many tin-mining companies are now earning big profits on a reduced output, and, as already mentioned, much encouragement is being given to the development of new tin producing enterprise. Had earlier sane counsels prevailed and adequate releases been made at £165, a price of nearly £250 would never have been reached, but unfortunately a shortsighted view was taken and the present state of affairs is the result. How to work the price of tin down to about £200 per ton without unduly upsetting all concerned is a query that takes some answering, but at the present general level of commodity prices £235 is certainly too high, and the growing scarcity of prompt tin a serious menace.

Past experience of production control in metals has shown that those responsible for the schemes of curtailment cannot resist the temptation of helping the price to rise once a turn in an upward direction has been achieved, and that losing sight of the original reason for reducing output they adopt the aggressive policy of bull operators, whose war-cry is, "Higher, Ever Higher!" It seems very apparent that this lust for gain has entered into the tin situation.

Annual Conference in Manchester

THIRD LIST OF SUBSCRIPTIONS TO CONFERENCE FUND

	£	s.	d.
Previously acknowledged	107	8	6
Messrs. Joseph Stubbs, Limited, Manchester	10	10	0
Messrs. J. W. Jackman & Company, Limited, Manchester	10	0	0
The Stanton Ironworks Company, Limited, near Nottingham ...	10	0	0
Messrs. Entwistle & Gass, Limited, Bolton	3	3	0
The Staveley Coal & Iron Company, Limited, near Chesterfield	3	3	0
Messrs. Leigh & Sillavan, Limited, Manchester	2	2	0
"The Iron and Steel Industry," London	2	2	0
Messrs. J. Parish & Company, Erith	2	2	0
The Penton Publishing Company, Limited, London	2	0	0
J. H. Jones, Esq., Swinton	1	1	0
Quest Products, Limited, Birmingham	1	1	0
Messrs. John Summers & Son, Limited, Shotton	1	1	0
T. W. Markland, Esq., Bolton ...	1	0	0
H. Stead, Esq., Manchester		10	6
F. Andrew, Esq., Manchester ...		10	0
Total	£157	14	0

Imported Chain or Pulley Blocks

MARKING ORDER RECOMMENDED

The Standing Committee appointed by the Board of Trade have reported on their inquiry as to whether imported chain or pulley blocks should be required to bear an indication of origin. The Committee have decided in favour of a Marking Order. They are satisfied that imports are appreciable, and that, in the absence of an indication of origin, there is a substantial possibility that purchasers may be in ignorance of their origin. They think it is desirable to limit the Order to chain blocks of metal, and concur in the applicants' proposal that the mark of origin should be cast or die-stamped on the block. The Committee do not see their way, however, to recommend the making of an Importation Order. Their recommendation is "that each imported chain block of metal, whether imported complete or in parts, should, on sale or exposure for sale, both wholesale and by retail, bear an indication of origin cast, die-stamped or incised conspicuously on the outer surface of the hand-wheel, or, where there is no hand-wheel, of the outer casing or side frame, or, where there is no hand-wheel or side frame, on the outer surface of the block." It is recommended that the Order should come into force three months after it is made.

Iron and Steel Production

The British Iron and Steel Federation, in its statistical bulletin for March, states that production of pig-iron and steel in the United Kingdom continues to expand; there was a net increase in the number of blast furnaces in operation of five during March, while pig-iron production increased from 414,400 tons in February to 503,600 tons in March, and steel production from 707,500 tons in February to 834,500 tons in March. Owing to the difference in the number of days in the respective months, the increase is not quite so great as is apparent. According to returns received from 153 firms, employing 114,595 workpeople, the average weekly earnings per head in February amounted to £3 2s., compared with £3 1s. 6d. in January and £2 19s. 10d. in December.

The Story of Saint Eloy

THE PATRON SAINT OF THE FOUNDRY INDUSTRY

At a banquet held in connection with a French Foundry Congress, Mr. Jules Ramas detailed the legend of Saint Eloy, the Patron Saint of founders and metal workers.

St. Eloy was not, in the proper sense of the word, either a foundryman or a smith. He was a jeweller, and at Limoges he worked the king of metals. Eligius, for such was his baptismal name, was born about the year 588, two leagues from Limoges at Chatelac, which still possesses souvenirs, especially at Solignac, where in the beautiful Roman church on the right-hand side of the Limoges road at Saint Yrieix there is a statue.

When quite young, he was apprenticed to the jeweller Abon, Mint Master at Limoges. He made rapid progress and exhibited fine moral qualities, so much so he quickly became a master jeweller. It is very probable that at this time jewellery from the Limoges district was of an extremely high standard, as it was probable that gold ore was mined locally. Numerous ancient mines, running into hundreds, have recently been found by that distinguished engineer, Mr. Roget. These mines, of which many date from the Roman occupation, could probably be exploited to-day with satisfactory results. Moreover, several historians have stated that Cæsar was attracted to Gaul because of the wealth of its gold mines, and it might also be assumed that the persistence of the English to conquer and occupy the South-West of France was because of the existence of precious metals.

Arriving at Paris, Eligius met King Clothaire's jeweller, called Bobon, and through the latter's intervention, Eloy was charged, not only to build a palace, but to manufacture a throne which, decorated with gold and precious stones, would provide a suitable setting for the Royal presence. According to a contemporary historian, "He accounted for every grain of gold confided to him, unlike many of his kind who made exaggerated claims for losses due to filing and melting. Actually he made two instead of one throne with the raw materials furnished." His probity as a jeweller and his skill as a workman excited the admiration of Clothaire to such a degree that he made Eloy his mint master, with apartments in the Royal Palace. He appreciated Eloy's qualities so much that he made him his confidential adviser in matters of state. After Clothaire's death, his son, Dagobert, who also held Eloy in high esteem, made him his counsellor. This did not prevent Eloy from continuing to practise his profession, and he created numerous masterpieces, such as the tombs of St. Martin of Tours, St. Denis, St. Severin, and St. Genevieve. Outside his artistic work he was much interested in the poor. He took a profound interest in the welfare of his workmen, and not only did he share their work, but additionally from time to time he shared with them the profits made by the workshop. His outstanding qualities procured for him the episcopal See of Noyon, which had authority over the regions of Tournai, Ghent and Courtrai. It stretched from Noyon to Antwerp, and during his occupancy of the See numerous churches and monasteries were created, and its population, still half barbarian, was converted to Christianity. That is why all the Corporations relating to metallurgy—locksmiths, gunsmiths, blacksmiths, nailmakers, whitesmiths, boilermakers, tinsmiths, plumbers and cutlers—in the middle ages in the north of France prayed to him as their patron saint.

The Mechanised Foundry of the Sterling Manufacturing Company, with Special Reference to the Enamelling Department

By Vincent C. Faulkner

The Sterling Manufacturing Company was founded about fifty years ago for the purpose of the manufacture of domestic wringers and garden rollers. The former business is apparently peculiar to Great Britain and certain colonies, as the only country to which exports of any note are made is Denmark. The consumption of these machines is of the order of a quarter of a million per annum, and the demand is of a constant character, varying only very slightly with the trade conditions.

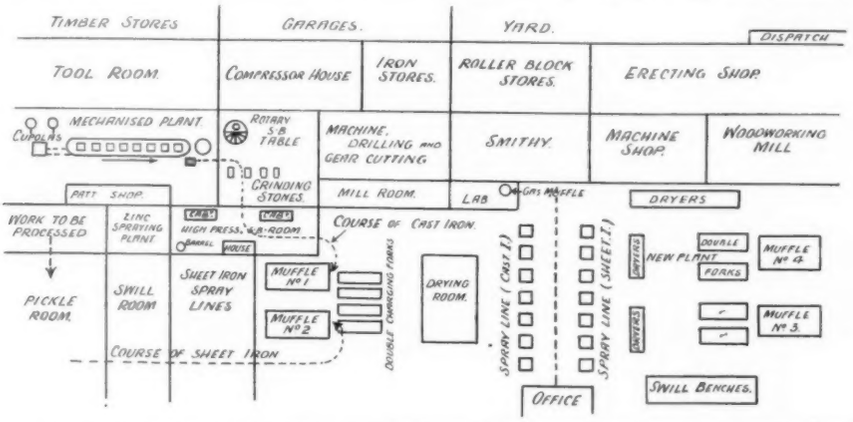

Fig. 1.—Diagram of the Lay-out of the Sterling Manufacturing Company, Cubitt Town.

Mr. B. B. Kent, the general manager, has always taken a profound interest in the work of the various technical societies in the London area, and a few years ago, during the visit of the London Branch of the Institute of British Foundrymen to the works of the Crane Company at Ipswich, he was casually introduced to the question of vitreous enamelling by Mr. Clayton, of the Incandescent Heat Company. Many wringers are placed outside ironmongers' shops and suffer rapid deterioration through canine attention and are constantly being returned to the manufacturers for repainting. By applying the vitreous enamelling process this nuisance was obviated and many of the former wood trays and boards could be replaced by enamelled castings and pressings, whilst a slightly higher price could be obtained for the finished product. Once having installed the vitreous enamelling process, Mr. Kent quickly found that his manufacturing facilities in the foundry were inadequate and, as a result, he decided to mechanise his production. This has enabled him to concentrate a greater production of castings into one-eighth of the space previously occupied, and make space available for an extra compressor room and pickling shop. As the works are situated at Cubitt Town, on the north side of the River Thames, naturally ground space is of very great importance. This development has not been an easy passage, as the ground upon which the works are built is of a made-up character, and a subterranean fire under the enamelling shops brought about their complete collapse and held up production for several months. When the reconstruction was carried out, the capacity of the enamelling shops was doubled, and now, after three months' working, this new plant is being again doubled and extra compressors, sand-blast equipment and muffles installed.

Melting Plant

The melting plant consists of two cupolas, one of which has been constructed from the funnel of an old Cunarder, whilst the other is a Thwaites. They are lined with a double row of firebricks down to 36 in. and are provided with a Ronceray syphon brick, which enables the production to be regulated from a maximum of 2½ down to 1¾ tons per hr. The cupolas are worked on alternate days and are patched with Silacene, and about 1 ton of this material is used to every 50 tons of metal mounted. Each cupola has four tuyeres, which are situated in one plane and are pointed slightly downwards.

The molten metal is teemed into hand shanks, and a matter of six paces brings it to the pouring station of the mould conveyor.

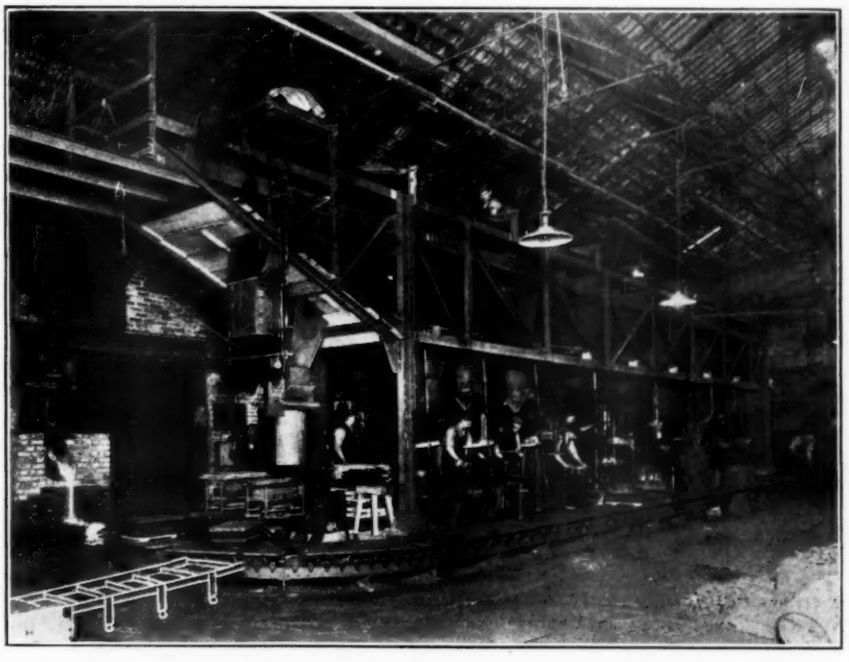

Fig. 2.—Foundry Plant installed by Universal System of Machine Moulding & Machinery Company, Limited.

The Mechanised Melting Plant

This plant, which has been designed by Bonvillain and Ronceray, is of the simplest possible character, and consists in principle of but three conveyors and two elevators. The castings are moulded on ten machines, over which runs the belt conveyor for the supply of moulding sands through hoppers situated above each, whilst surrounding them is the mould conveyor. Most of the machines work in pairs, and the moulds are assembled on conveniently-situated stools placed at the side of the machines, and are then placed on the mould conveyor, which carries the moulding box past the pouring station and along to the knock-out. The knock-out is also of the simplest possible character, and consists of a grating, and sand dropping through it feeds into the boot of an elevator the interior of which is zinc lined to prevent sticking. This elevator is of the type whereby pressed-steel buckets are attached to fabric belting. The elevator is enclosed in steel sheeting to create something of a chimney effect so as to introduce a modicum of cooling. The sand then passes over a magnetic separator, which discharges iron shot down a shoot into a barrow. The sand is then passed over a vibrating screen, which effectually rids it of any hard pieces of core and the like, and feeds on to an 8-ft. Ronceray continuous rubbing mill. The stream of sand leaving the mill falls into the boot of a second elevator, of a similar character to the first, which feeds the belt sand conveyor. From this conveyor the sand is ploughed off into the hoppers supplying the moulding machines. The ploughs consist of a piece of strip steel, and their distance above the belt is regulated by the interposition of wooden wedges. In order to save the wear on the belt, Mr. Kent has fastened on to these ploughs a strip of ballata belting. Originally, at the end of the conveyor belt there was a shoot for any excess sand still available after filling all the hoppers, but it has been decided to spill on to another short length of belting which will feed an additional hopper to be placed outside the area enclosed by the mould conveyor. This will enable the larger sizes of the side-members of wringing machines and odd parts to be made, and, by means of a short length of a gravity roller conveyor, to be pushed on to the mould conveyor to be teemed and sent to the knock-out and the boxes returned to the moulding station.

The mould conveyor travels at a speed of 9 ft. per min., but the speed can be varied up to 20 ft. per min. by means of a gearbox, and is

driven by a 3-h.p. motor. The sand conveyor also takes a 3-h.p. motor, whilst for the balance of the plant a 10-h.p. motor is used. The hoppers supplying the moulding machines have two sides in the definitely vertical plane.

Emergency switches are placed in handy positions for stopping the whole plant. All the pattern plates are electrically heated and are

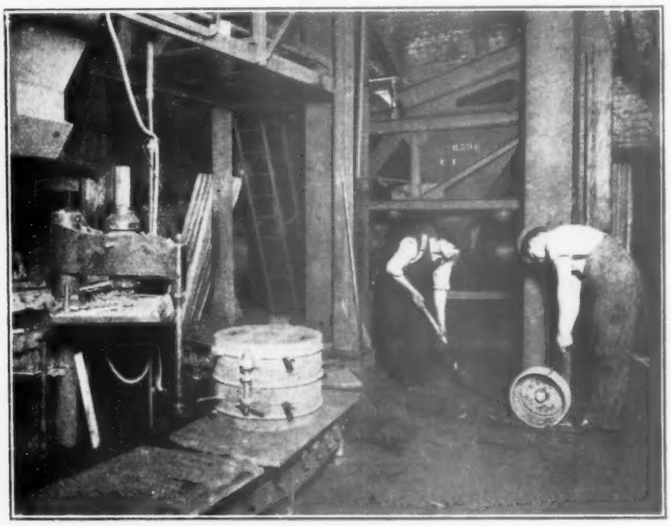

Fig. 3.—Knock-out.

capable of maintaining three distinct temperatures, the higher temperatures being used when the system sand becomes warmed up. The method of working is to change the pattern plates daily, but not during the day. Most of the pattern plates are made from a lead-antimony alloy, but aluminium and bronze are also used, bronze being used for the pattern for the garden rollers, which involves a very deep strip.

Moulding Plant

The moulding plant consists of a machine of special design for making the "bows" of mangles and a pair of hand-rammed stripping machines. The pair share one sand hopper and the sand is directed to either of the machines by a hinged pipe suspended from the bottom of the hopper. Next, there are three P-type snap flask machines operating on miscellaneous small castings. Then there is a pair of machines, an O.P.5 and a R.P.5, which make the top and bottom portion of the castings for the garden rollers. This involves something of the order of 12-in. lift and about ten of these are made per hr. Finally, there is a pair of A.F.P.60 machines, which are engaged upon the production of gas-oven parts., mangle sides and road-traffic indicators, etc. The composition of the metal used for all these castings has been standardised to give an iron of which the following is a typical example:—T.C. 3.24, Gr 2.66, C.C. 0.58, Si 2.02, S 0.10, P 1.23 and Mn 0.59.

The castings are at present taken away by barrows, but a conveyor line is being installed and, straightaway put through a Guttmann 8-ft. 6-in. rotary sand-blast machine, operating at 22 lbs. pressure. After sand-blasting, any flash is ground off on one of three sets of double-ended grinders. As most of the castings have to be enamelled, they are passed through either a second sand-blast machine or one of two Jackman cabinets or a house, and are subjected to sand-blast, or rather No. 16 shot-blast, using 75 lbs. pressure. The rotary table is used during the night shift at high pressure on all flat castings to be enamelled.

Compressor House

In the compressor house are installed seven air compressors, five by Reavells, of Ipswich, one by Jackman and a French machine, which have a total of 300 h.p. All are capable of giving pressures of 30, 60 or 90 lbs. per sq. in. Great elasticity is afforded by the fact that there are no less than 20 valves, which make it possible to provide any of these pressures from any of the machines at any of the delivery stations. Cooling water is pumped from a well and by means of a special device any interruption in the supply of water automatically operates the overload device on the starter and stops the motor.

Enamelling Department

Referring to Fig. 1, it will be seen that, despite the fact that the works is of long establishment, the processes are methodically interlinked and passed through the works in a virtually straight line. The raw materials for the enamelling process consist, in the main, of frit, various colouring oxides, clay, tin oxide, and, of course, water. Since the establishment of the Enamelling Department a large quantity of work is undertaken in connection with sheet steel and, owing to the difference in the expansion of cast iron and sheet steel, slightly different enamels have to be used, to take care of the expansion for the grey basecoat. The Sterling Company started off with the following mixture:—300 lbs. of clear frit, 9 lbs. of tin oxide, 12 lbs. of clay, 12 ozs. of black oxide and 35 lbs. of water. This material is ground-down in one of several ball mills. The balls used are either flint pebbles from Dieppe or porcelain enamel balls. The material is ground to 6 units, *i.e.*, from 50 c.c.'s of liquid enamel, 6 grams are left on 150-mesh sieve. The ground enamel, prior to spraying, is passed over magnetic separators and vibrating sieves and is then checked for consistency by means of a stop-watch and flow meter. For the mottle enamel, which is largely used, the following mixture has been found to give satisfaction:—50 lbs. of white frit, 2 lbs. of clay, 2 lbs. of tin oxide and 15½ lbs. of water.

In the mixing shop a proper system of drainage has been incorporated, and the liquid collecting in the sump is pumped out and passed through the finest mesh sieve. The material thus retained is returned to the mills. It is this factor of conserving waste which has modified the original mixture which we have detailed above, for, in addition to the recovery of the spilt material in the mixing house, all the splashings from the spraying cabinets are also recovered.

The two great enemies of successful vitreous enamelling are grease and rust spots. As many used gas-stoves are received in this works for re-conditioning and enamelling, the problem of grease removal is effected, in this case, by stoving at a reasonably high temperature. It is interesting to recount, in this connection, that many types of iron must be entering the factory, yet it has been found possible, successfully, to enamel practically all of them. The sheets are differently handled, and the process given to them will be described later. There are ten spraying-cabinets, and above each one is a small storage tank which, by gravity, supplies spraying guns of the Aerograph type. After spraying, the castings or sheets are quickly transferred to a 25- by 15-ft. drying house, entering at the spraying side and leaving at the furnace side. This room is maintained at a temperature of 160 deg. Fah. It is constructed of double-asbestos boarding. The heat is supplied by zig-zagging in flues constructed beneath the floor, the waste gases from the enamelling furnaces. Before being returned to atmosphere they are cycloned across the whole volume of the room at a reasonably high speed.

In the near future, the door to the drying house will be automatically controlled by the invisible-ray method. This will allow sufficient time for an employee to enter, deposit the casting and return. Should, however, the time-interval be insufficient, there will be conveniently placed on the inner side of the door a push-button control.

Fig. 4.—Jackman Sand-blasting Cabinet.

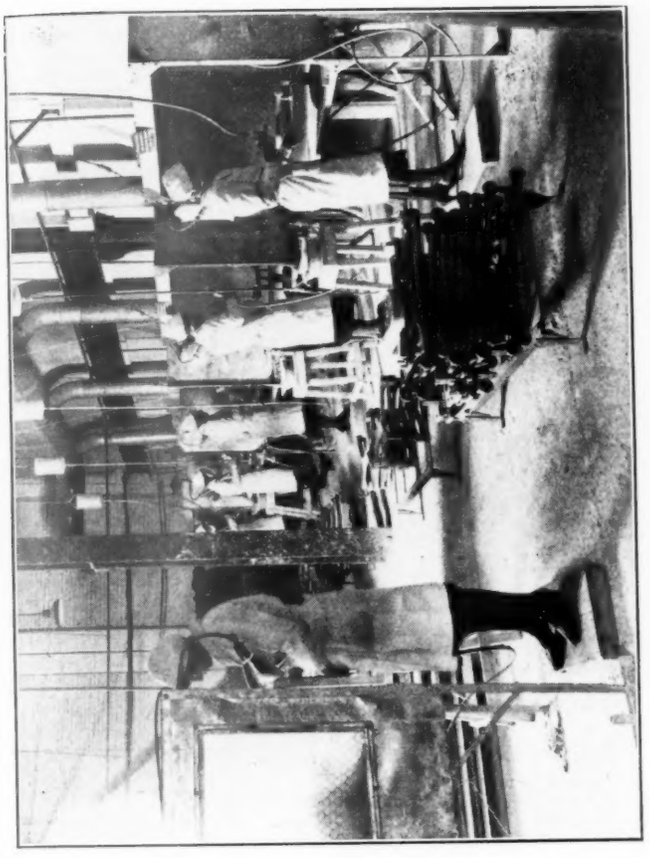

Fig. 6.—Cast-Iron Spraying Line.

Fig. 8.—Muffle End of Enamel Plant.

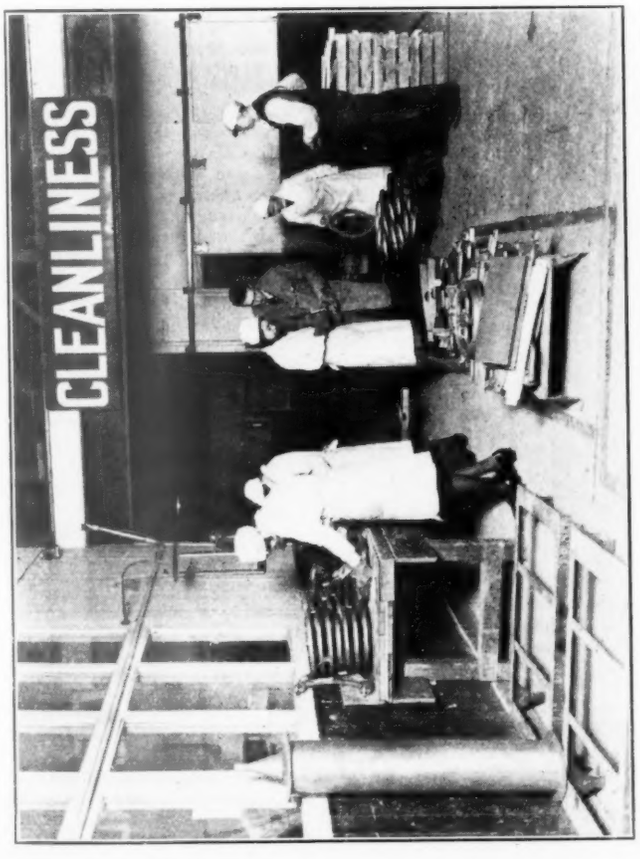

Fig. 5.—Inspecting Sand-blasted Castings and Water-Softeners prior to Spraying.

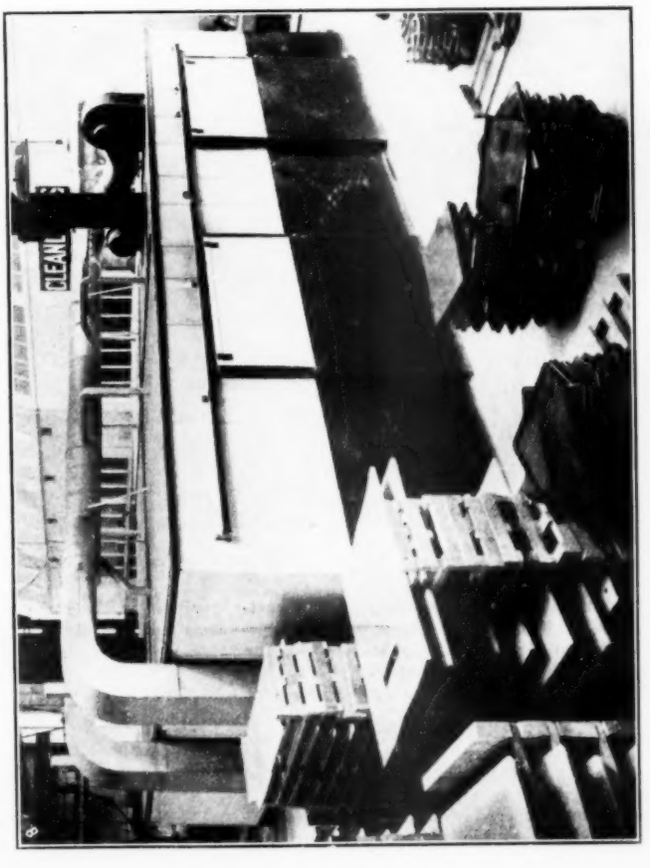

Fig. 7.—Close-up of Drying Room, showing Method of Circulating Hot Air by Means of Sturtevant Fan.

There are installed two furnaces, having hearths 12 ft. long by 4 ft. 6 in. wide by about 3 ft. high, which have been installed by the Incandescent Heat Company. The older one has but one oil burner, which, at the present time, is burning creosote. The second one is what is known as the Equiradiant type. A temperature of 720 to 740 deg. C. is maintained for cast iron, whilst sheet steel is treated at 820 to 900. The perretts used are made by the Cronite Company and have the following composition:—Si, 1.50 per cent.; Ni, 7.08 per cent.; and Cr, 13.05 per cent.

The furnaces are charged on double-charging forks, a close-up view of which is shown in Fig. 9. The capacity of the ovens has been reinforced to the extent of 500 per cent. by the use of Cronite bars, which enables certain castings to be suspended and others to be double-decked. Castings weighing up to 10 cwts. are regularly enamelled, whilst special plant has been devised for handling water-softener parts.

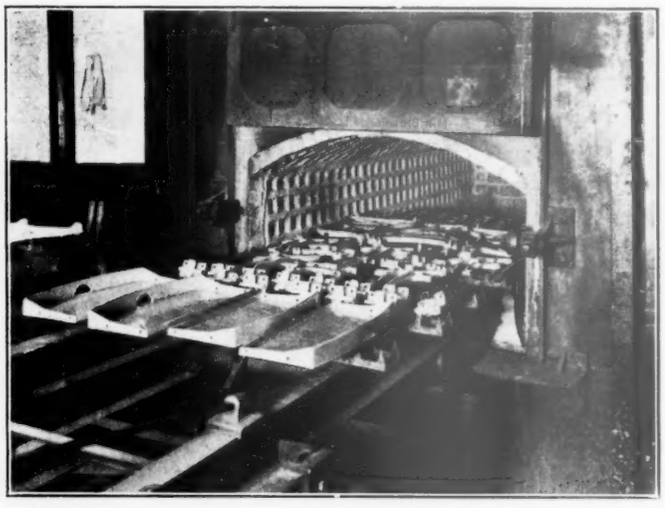

Fig. 9.—Mangle Parts Entering No. 1 Muffle.

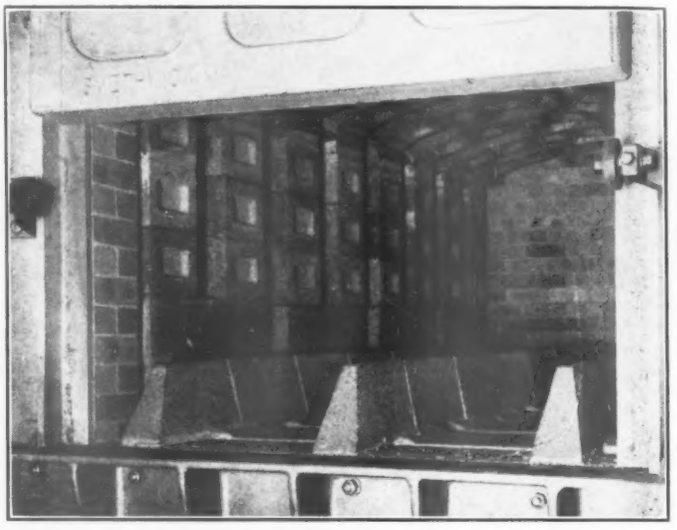

Fig. 10.—Interior of Equi-Radiant I.H.C. Muffle.

Fig. 11.—Final Inspection of Mangle Castings.

Sheet Metal Enamelling

As it would occupy valuable muffle space, to rid sheets of grease by heating to an elevated temperature, recourse is made to the use of the trichlorethylene process, developed by Imperial Chemical Industries, Limited. The plant consists of an electrically-heated galvanised tank controlled at a temperature which causes the trichlorethylene to boil, and so fill the tank with vapour. Towards the top of the tank cooling coils are fitted, which limits the height of the vapour. This non-inflammable vapour condenses upon the cold sheets and falls back, grease laden, into the tank. The sheets are thoroughly cleaned after but a few moments' insertion, and are transferred successively to acid, water alkali and borax-washing vats. An additional hot room is maintained for their drying, in order to effect this operation as quickly as possible with a minimum loss of time due to transport, and all these operations are carried out under a circular overhead runway. The now clean and dry sheets are ready for enamelling, which is virtually the same process as that previously described for cast iron, except that the spray guns are pressure fed from 15-gall. containers.

Acknowledgments

The author wishes to acknowledge, with sincere gratitude, the help accorded to him by Mr. B. B. Kent and his brother, Mr. A. B. Kent, in the preparation of this article.

The increase in the application of porcelain enamel can be seen by the following list of articles processed during the last month:—Mangles and wringers, domestic-coke boilers, electric fires, gas-irons, gas-fires, water softeners, gutters and rain-water pipes, gas-cookers, fire grates and surrounds, tombstones, cooker splash plates, flue pipes, geysers, jam boilers, roof tiles, refrigerators, shelves and sinks.

Book Review

Mechanical Technology. By G. F. Charnock. Second Edition. Revised and enlarged by F. W. Partington. Pages 725, with 529 illustrations. 1934. London: Constable & Company, Limited. (15s.)

Part 1 of this ambitious work covers the production and properties of pig-iron, wrought iron, carbon steels, alloy steels, brasses, anti-friction metals and light alloys. Chapters are also devoted to timber, stone, concrete, oils, lubricants, leather, india rubber, plastics, etc.

Part 2 deals with processes depending upon the fusibility of metals, *i.e.*, moulding, die casting, etc., whilst Part 3 deals with forging, stamping, wire drawing sheet-metal working, etc.

The Preface tells us that this work is intended for beginners and those with limited time at their disposal. Consequently it is particularly unfortunate that it is so loaded with unnecessary matter and with inaccuracies. It is now scarcely necessary to describe the cementation process and the manufacture of shear steel in such a work as the present, particularly in view of the fact that blister bar is now seldom used in crucible melting and shear steel is very nearly unknown. The Héroult furnace is not a resistance furnace, but, to all intents and purposes, a pure arc furnace. In Chapter IX the word "pipe" is correctly used, but in Chapter XIV it is incorrectly used to describe a defect in a sintered product, whilst in Chapter XLI it is applied to a defect created during forging and for which the word "burst" is usually used. Kanthal is not a nickel-chromium alloy. The safe-working temperature of Cronite is far above 1,500 deg. Fah. It is at least 1,900 deg. Fah. It is ridiculous to say that Nichrome can be used up to about 3,000 deg. Fah., as that is above its melting point. Incidentally, one may here remark it is now usual to use the Centigrade-temperature scale in metallurgical works in this country for obvious reasons. Besides being inaccurate, the arrangement of this book leaves much to be desired. For instance, Invar is dealt with on page 141 and again on page 207, whilst the piping of ingots is described first on page 115 and again on page 319, both pages being illustrated by different, but very similar, diagrams. J. F. K.

The Addition of Molybdenum to Cast Iron for Foundry Purposes*

The importance of the influence of molybdenum on the properties of cast irons is becoming increasingly appreciated, and there is no doubt that as investigation and knowledge of this influence progresses, molybdenum will come to be regarded as one of the most important of the alloy additions to cast iron. From existing knowledge of the influence of this element, it is clear that quite small quantities exert a profound influence on the properties of cast iron, and it follows from this that variations in percentage of quite a small order are likely to be of great importance to the accurate control of molybdenum cast iron. On the economic side, molybdenum is a comparatively expensive element. As a rough calculation based upon present-day values, the added cost per ton of iron due to the intrinsic value of the molybdenum is £5 per ton per each 1 per cent., or 10s. per ton per each 0.10 per cent. It will be clear from this that inaccuracies in the addition or losses of quite a small order may add considerably to the cost of such alloy cast irons, and it is therefore a matter of considerable industrial importance to investigate carefully the methods of making additions of this element to cast iron.

The melting point of pure molybdenum metal is very high and is given as 2,620 deg. C. It is amongst the highest melting point metals known. Fortunately, the alloying of iron and molybdenum is accompanied by a very large reduction in the melting point. With 50 per cent. of iron, the melting point of molybdenum is reduced from 2,620 deg. C. to 1,540 deg. C., over 1,000 deg. C., and the lowest melting point alloy of the system is the eutectic containing approximately 36 per cent. molybdenum, and melting at a temperature of 1,440 deg. C. It is of importance to notice the extremely wide solidification range of the molybdenum rich alloys containing over 50 per cent. molybdenum. An alloy containing 75 per cent. molybdenum, a very common commercial percentage in ferro-molybdenums, commences to melt on heating up at the approximate temperature of 1,540 deg. C., and melting is not complete until a temperature of approximately 2,100 deg. C. is attained. It is stated that an alloy containing 80 per cent. molybdenum and less than 1 per cent. carbon cannot be tapped out of an electric furnace on account of its high melting point. In the alloys containing less than the eutectic composition, *i.e.*, 36 per cent. molybdenum, the effect of diminishing percentages of molybdenum is not very great in increasing the melting point of the alloys as the melting point of the eutectic at 1,440 deg. C., is less than 100 deg. C. lower than the melting point of pure iron.

The molybdenum iron alloys containing carbon have not been sufficiently investigated to enable accurate data to be given as to the effect of carbon on the melting points of the molybdenum rich alloys. The various molybdenum carbides which have been reported all have melting points over 2,000 deg. C.

Materials Available for Making Molybdenum Additions

Molybdenum is available in the usual form of ferro-alloys, the most common being the carbon-free variety containing from 60 per cent. to 80 per cent. molybdenum. These ferro-alloys are made from the reduction of raw molybdenite concentrates, using either carbon or silicon. The process can be carried out either in crucibles or electric furnaces, and the requisite amount of iron is added in the form of turnings. Molybdenum additions to ferrous materials are made also by the use of the oxides either direct or in the form of calcium molybdate. Molybdenum trioxide MoO_3 unites vigorously with lime at temperatures of 650 deg. C. to 760 deg. C. to form calcium molybdate $CaMoO_4$, and this compound is manufactured commercially, a typical analysis of the commercial product being as follows:—(Analysis by Hardy, "Metallurgist," 1930, Vol. 6).

	Per cent.
Molybdenum Trioxide (MoO_3) ..	60.75
Equivalent Molybdenum Metal ..	40.50
Lime (CaO)	23.30
Iron Oxide (Fe_2O_3)	3.72
Equivalent iron metal	2.60
Alumina (Al_2O_3)	0.79
Silica (SiO_2)	9.70
Sulphur	0.22
Phosphorus	0.014
Loss on ignition	1.37

A commercial product is marketed under the name Molyte for use in making additions in steel manufacture. This product is described in U.S. Patent No. 1,681,123/Aug./1928 as a material "comprised of a mass fused from a mixture of molybdenum oxide and a flux-forming oxide, the mass containing molybdenum oxides lower in oxygen content than molybdenum trioxide." It is claimed that Molyte has a greater density than commercial calcium molybdate and will therefore sink more rapidly through a bath of slag and also that it required less reduction in the furnace by virtue of the fact that the trioxide is partially reduced in the process of manufacture.

Refined Molybdenum Pig-Irons

Refined pig-iron containing molybdenum in all percentages in combination with silicon, manganese, and phosphorus percentages have been recently introduced by Bradley & Foster, and are available for use direct or for the addition of molybdenum to pig-iron mixtures. Typical analyses of a variety of such irons are included in Table I as examples of the varied range of compositions which can be obtained.

TABLE I.—*Chemical Analyses of Refined Molybdenum Alloy Pig-Irons.*

Specification No.	Total Carbon.	Silicon.	Manganese.	Sulphur.	Phosphorus.	Molybdenum.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
41.C. ..	2.73	0.91	0.45	0.033	0.22	1.25
46.C. ..	2.70	1.22	0.76	0.036	0.18	1.02
48.C. ..	3.87	1.41	0.95	0.028	0.15	2.09
49.C. ..	2.67	1.67	1.03	0.030	0.23	1.44
51.C. ..	3.32	1.70	0.90	0.045	0.22	0.91
50.C. ..	2.67	2.09	1.10	0.028	0.21	2.35
52.C. ..	3.37	2.54	1.03	0.042	0.27	1.05
S.S.C. ..	3.25	1.45	0.55	0.063	0.10	8.50

In the table, the analyses of specimens showing Mo content of from 1.0 to 8.50 per cent., silicon contents of from 1.0 to 2.5 per cent., and total carbon of 2.70 to 3.87 per cent. are given.

Methods of Adding Molybdenum to Cast Iron

Any discussion of the methods of adding molybdenum to cast iron is intimately bound up with the methods of melting in use. In those cases where the cast iron is melted in electric furnaces, hearth furnaces such as air furnaces or rotary powdered fuel furnaces, it is possible to use methods similar to those adopted in steel melting practice where calcium molybdate or molyte are frequently used. The satisfactory use of these compounds necessitates ample time for their reduction. On this account they are not suitable for direct addition to molten metal in the ladle. In hearth type furnaces it is recommended that the best practice is to bury the calcium molybdate or molyte in the centre of the charge or distributed throughout the charge in bags or in briquetted form before melting down. Alternatively, these molybdate salts can be added to the molten charge any time prior to two hours before tapping, and in the case of the hotter electric furnace working, any time up to half-an-hour prior to tapping. Hardy, who has studied these methods of making Mo additions, very carefully states that it is not possible, utilising these methods, to work to the same close chemical limits as used in steel making. This investigator states that, in general, calcium molybdate can be used satisfactorily only in cupola practice, if the cupola is engaged solely on the production of molybdenum cast iron. Lorig, of the Batelle Memorial Institute, found that calcium molybdate tends to oxidise part of the carbon, silicon, and manganese in cast iron, and that its use thereby makes it difficult to control the chemical composition. Summarising, it would appear that the use of calcium molybdate or molyte as a means of adding Mo to cast iron is not likely to be satisfactory under ordinary conditions of foundry practice, and its use should be contemplated only under those conditions where ample time can be allowed for the reactions involving the reduction of the molybdenum trioxide.

For additions to cast iron, the use of ferro-molybdenum is most frequently recommended, and it is stated that despite the high melting point of the rich ferro-molybdenum, they dissolve in molten cast iron quite readily, and it is unnecessary to heat the iron to a temperature higher than that normally employed, even when preparing alloy cast irons containing the maximum amount of this element necessary for any purpose. In all cases where the ferro-alloy is used it is recommended to use a crushed grade. The Climax ferro-molybdenum, containing 60 to 65 per cent. molybdenum, is available in two grades, No. 2 consisting of 1/12-in. particles, and No. 3 grade 1/20-in. particles or smaller. This granulated material must be used when making additions to the molten metal in the ladle. In making such ladle additions, the whole charge of ferro-alloy may be contained in a trough of semi-cylindrical section or in a kind of stoppered funnel from which the powdered alloy can be added continuously to the stream of molten metal as it flows into the ladle. In all the recommendations as to ladle additions, it is stated carefully that the ladle of metal should be allowed to stand if possible, at least three or four minutes prior to pouring. Further, it is not recommended to attempt molybdenum alloy additions to very small quantities in the ladle, and possibly a weight of 200 lbs. may be considered as the minimum weight which ought to be treated by this method of ladle additions.

These precautions serve to remind one of the inherent difficulty of ensuring correct alloying of ladle additions of ferro-molybdenum. This arises entirely out of the final high melting point of this material. In spite of the allegation that ferro-molybdenum readily dissolves in molten cast iron, it is important to remember that there is a difference between ready solution and ready disappearance when ferro-molybdenum is added to molten cast iron. The very long melting range of ferro-molybdenum referred to earlier would lead one to anticipate ready disappearance of visible solid particles of the ferro-alloy, as it commences to melt at a temperature not very greatly different from that of molten cast iron. The final melting point of the alloy at a temperature of over 2,000 deg. C.

* From Bradley's Magazine.

is well above that of ordinary cast iron, and unless ample time is allowed for the diffusion of the higher melting point remnants of the ferro-molybdenum true solution or alloying of the molybdenum cannot take place. Actual observations on the behaviour of ladle additions of finely powdered ferro-molybdenum lead one to suspect that something of this nature occurs. When 60-mesh ferro-molybdenum was added to small quantities of molten iron in spite of the fact that analysis showed the desired percentage had been attained, in the alloy the properties were quite different to those of the same metal, which was reheated in a crucible after the addition had been made. The machined surfaces of the straight ladle addition showed a uniform fine-grained structure, which had all the appearance of undissolved fine particles of molybdenum rich material. It is quite possible that many of the cases in which the full benefit of Mo has not been realised are due to the fact that the element is not wholly in solution or alloyed with the material.

Whilst molybdenum behaves very much like nickel and undergoes negligible loss on passing through the cupola, the difficulty of incorporating this element uniformly and with regularity when added to the cupola charge in the form of the ferro-alloy is exactly the same as when using any other rich ferro-alloy material. Unless a large quantity of the mixture is tapped out at any one time, it is extremely difficult to ensure the ferro-alloy being uniformly mixed with the charge.

The most satisfactory method of incorporating molybdenum with cast iron is the use of a pig-iron containing a small quantity of the element as compared with the ferro-alloys, or, alternatively, the direct production of the desired alloy by remelted pig-iron of the correct composition initially. Smalley, in his early experiments on the molybdenum alloy cast irons, utilised this method by preparing a crucible melt of 8 per cent. molybdenum pig-iron. This was used for the addition of molybdenum to his subsequent mixtures. From a study of the work already done on the ternary iron-carbon-molybdenum alloys, it is clear that the effect of this element in quantities up to 10 per cent. on the melting points of the higher carbon alloys is not exceptionally great. This range of molybdenum contents covers practically all the commercial grades of refined molybdenum alloy pig-irons, and it is clear that these irons may be expected to melt and alloy quite readily with the usual type of cupola melted mixtures.

In this more dilute form, the loss of molybdenum undergone in remelting under good cupola conditions is of a very small order. Several experimental results obtained in the production of alloy cast irons containing varying amounts of molybdenum from 0.25 to 1.5 per cent. show maximum losses of 2 per cent. of the Mo added when using a pig-iron containing an initial Mo content of 2.5 per cent. This compares very favourably with the loss of 10 per cent. quoted by Brick of the Cadillac Motor Car Company when using ferro-molybdenum as a cupola addition. From an economic point of view, the difference in loss amounts to a saving of 7½ per cent. of the molybdenum added, and this is by no means an inconsiderable amount with an expensive element of this nature. In addition, all risk of incomplete alloying of the element is eliminated and the use of such molybdenum rich pig-irons can be resorted to under conditions of cupola practice where only comparatively small quantities are drawn from the furnace at each tap.

MESSRS. COX & DANKS, LIMITED, announce that the work which has been proceeding for the past twelve months on their new scrap depôt at Frederick Road, Pendleton, Manchester, is now completed, and the yard is ready for use.

Lancashire I.B.F. Branch Annual Meeting

NEW OFFICERS APPOINTED

The annual meeting of the Lancashire Branch of the Institute of British Foundrymen was held at the Engineers' Club, Manchester, Mr. A. Phillips, the Branch-President, occupying the chair.

The minutes of the previous annual meeting and the annual report and statement of accounts for 1933 having been adopted unanimously, the honorary secretary (Mr. J. E. Cooke) then presented his annual report of the transactions of the Branch, as follows:—

In the time available the many activities of the Branch during the period under review can only be summarised, but a very large amount of valuable work has been accomplished, and the interest and enthusiasm of the members has been well maintained. This feature is common to the Burnley and the Preston Sections as well as to the parent Branch.

Membership has been maintained at the previous year's total of 390, made up of:—

Subscribing firms and their representatives, 27 (increase 2); members, 106 (increase 3); Associate members, 236 (decrease 6), and Associates, 21 (increase 1).

By the courtesy of the managements of the Lancashire Steel Corporation, and of Messrs. Newton Chambers & Company, Limited, visits to Irlam and Sheffield were arranged. The popularity of the first named necessitated two visits, and a total of approximately 150 members inspected the Irlam Works; 80 members visited the Thorncliffe Works at Sheffield.

The annual picnic to Grindleford was exceptionally enjoyable. The 75 members and friends who participated in the outing count this a very happy memory.

The winter session opened with a social, organised jointly with the Junior Section, 125 people attending. The lectures during the session have been well attended, the average attendance being 79, and the change of meeting place to the Engineers' Club appears, from this point of view, to have been justified.

The annual dinner was a great success, and a record attendance of 229 was set up. Many expressions of appreciation of the efforts of the Dinner Committee have been received. At this function three members of the Branch, Messrs. H. E. Beardshaw, E. J. L. Howard and W. West, were presented with the Diploma of the Institute.

A very considerable amount of preparatory work in connection with the Annual Conference, to be held in Manchester from June 5 to 8, has been carried through by the Committees set up for this purpose, and appreciation of the efforts of the Ladies' Committee should also be recorded.

Attempts to increase the interest of apprentices and young men on the educational side are only partially successful. Efforts to remould the activities of the Junior Section are in hand, and the foundry classes at Openshaw Municipal Technical School urgently need support and active sympathy from employers and employed. Relations with other technical societies have remained cordial, and several successful joint meetings have been held.

The report would not be complete without an expression of the gratitude of the secretary for the assistance he has received from the President, the Branch Council, and officers of the Burnley, Preston, and Junior Sections, and from the general secretary and his staff during the year. The cordial co-operation of the general body of members is also very much appreciated.

Upon the motion of MR. H. V. GRUNDY, seconded by MR. A. KEY, the annual report of the hon. secretary was unanimously approved and adopted, the meeting heartily expressing by acclamation its approval of the highly efficient way in which the hon. secretary had carried out his duties.

Vote of Thanks to the Retiring President and Officers of the Branch

MR. W. HOLLAND proposed that a hearty vote of thanks be given to the retiring President and officers of the Branch for their services during the past year, saying that under the presidency of Mr. Phillips the efficiency of the Branch had been fully maintained and that the year had been a very successful one.

MR. ELLIS FLOWER seconded the vote of thanks. He could assure all those present that the work of the Branch had been carried out with the utmost efficiency during the past year. He was quite sure that the retiring President must feel highly gratified when he recalled the great support he had received during his term of office. The work which had been carried out by the hon. secretary was beyond all praise.

The vote of thanks was carried unanimously.

The RETIRING PRESIDENT (Mr. A. Phillips), responding to the vote of thanks on behalf of himself and the retiring officers, thanked the members and officers for the splendid support they had given him during his very enjoyable term of office. He had been able to make many friends, and he hoped to retain their friendship in the years to come, whilst he had also acquired a great amount of information which he knew would be useful to him in the future.

Election of President

The RETIRING PRESIDENT (Mr. A. Phillips) said that it was now his duty to ask the Branch to endorse the action of the Branch Council in nominating Mr. W. Norman Cook to be President for the forthcoming session. The decision had been unanimous. Mr. Cook would have a strenuous year of office, owing to the Annual Conference of the Institute taking place in Manchester in June. As to the past, he had undoubtedly put in a very great deal of hard work in the service of the Branch, as well as of the Institute generally.

Mr. Norman Cook was then unanimously inducted into the presidential chair.

The PRESIDENT (Mr. W. Norman Cook) thanked the Branch members very sincerely for the very high honour they had paid him by electing him as their President. He confidently counted on the support of all the members during his term of office. At the present time the whole of the members of the Institute were looking to Lancashire to do something of an outstanding nature in regard to the Annual Conference, and therefore it was incumbent upon them all to justify the hopes which were reposed in them.

The following named gentlemen were then elected officers of the Branch:—*Senior Vice-President*, Mr. John Jackson; *Junior Vice-President*, Mr. Jos. Hogg. *Members of Council*: Mr. T. L. Beech, Mr. R. A. Jones, Mr. James Taylor and Mr. A. Hopwood. *Representatives to General Council*: Mr. J. S. G. Primrose, Mr. J. Masters, Mr. E. Flower, Mr. W. H. Meadowcroft, Mr. Jos. Hogg, Mr. R. A. Miles and Mr. A. Phillips. *Auditors*: Mr. A. Burgess and Mr. A. Hopwood. *Representatives on Technical Council*: Mr. E. Longden and Mr. J. S. G. Primrose. *Hon. Secretary*, Mr. J. E. Cooke; *Assistant Hon. Secretary*, Mr. R. R. Hargreaves.

THE WHESSOE FOUNDRY & ENGINEERING COMPANY, LIMITED, of Darlington, are to supply the blast-furnace gas-cleaning plant to be installed at the Clyde Ironworks of Messrs. Colvilles, Limited, Glasgow. The plant is to be on the Whessoe electrical-precipitation system, and, except for the use of a small quantity of water for pre-cooling, will be entirely dry in operation. The plant is to cool, clean and boost 4,000,000 cub. ft. of gas per hr. (measured at N.T.P.) and the clean gas containing less than 0.05 gramme of dust per cub. metre will be used for stoves, boilers and steelworks purposes.

Potentialities of Cast Iron

RECENT RESEARCHES OPEN UP FRESH AVENUES OF APPLICATION

It so happened that the last two meetings of the session held by the London Branch of the Institute of British Foundrymen dealt with the subject of alloyed cast iron. The first was by Dr. Everest and the second by Mr. Hunt, the winner of the short Paper competition. The discussions on these two Papers are summarised below. Commenting on Dr. Everest's Paper, MR. V. C. FAULKNER (Past-President of the Institute) asked if negotiations were afoot for instituting prolonged sea-water immersion tests for the new varieties of alloyed cast iron, as recently published tests had shown that cold-blast and even ordinary cast iron had withstood such tests remarkably well.

Irregularities in Alloy Additions

MR. A. R. BARTLETT (Past-Branch-President), who asked for information as to the proper way in which to add alloys in cupola practice, said that in an American Paper he had read some time ago reference was made to three or four different methods of melting alloy iron. Although a duplex system, the cupola, and so on, were referred to in that Paper, there were no definite findings as to which method was the best; but there was an insinuation that the cupola was a good medium for melting metal of that description.

He had been concerned with the manufacture of parts for some pumps which were to be used for pumping abrasive materials, and the mixture used for making these parts contained approximately nickel 4.23 to 4.25 per cent. chromium, 1.5 to 1.6, silicon 0.65, manganese 4.5, sulphur 0.02, and phosphorus 0.1 per cent.; there were also slight additions of cobalt and copper. The mixture was melted in the cupola. The addition of nickel at the spout had been tried, and in a way it was quite successful, but that had been dropped. The analyses, however, indicated the irregularity of the results obtained; there had been losses up to 40 per cent. in silicon, 30 per cent. in manganese and 20 per cent. in chromium, but there was no loss of nickel; having regard to the losses in these other elements, the nickel percentage showed an increase, of course. Mr. Bartlett asked if Dr. Everest could give some reasons for these changes. The metal must possess a Brinell hardness of 700, and it was found that the Brinell figures obtained fluctuated.

In hard, heavily-alloyed castings there was excessive contraction, and there was a tendency to tear in places, such as at the junction of a branch and the body, so that care must be taken to mould in such a manner that tearing would not occur at such junctions.

With regard to melting, it was the practice to make a very heavy bed; the metal was run specially on one day only, so as to try to superheat the cupola before the blast was put on, the melting was carried out as rapidly as possible, and the temperature at the spout was about 1,400 deg. But there was something in the ingredients which seemed to cool off very rapidly, and there was the possibility that the last of four or five castings would not run.

With regard to dies for pressing motor-car parts, he said that reference had been made in the Paper to nickel additions of 36 per cent. Under present-day commercial conditions, however, customers did not want to pay for such high nickel additions, though they wanted efficiencies such as could be obtained with alloys containing high nickel contents.

DR. EVEREST said that the 36 per cent. nickel dies to which he had referred were only very small dies for compressing *papier maché*, and not motor-car parts.

Vibration Resisting Properties

DR. MAURICE L. BECKER (Depart. of Metallurgy, National Physical Laboratory), after commenting that undoubtedly cast irons, and particularly the special cast irons, were finding an increasing field of usefulness, said that until he had heard the Paper read he had not realised that the property of resisting vibration was likely to be of such value in cast iron. One would have thought that a material from which vibration was rapidly damped out might possess this property as a result of a certain amount of internal slip. He asked if Dr. Everest considered that that was the cause, and, if so, how he brought that fact into line with the alleged high fatigue resistance, because, so far as was known, whenever slip occurred there was a very good chance of starting the formation of a fatigue crack, and as soon as a crack started it had, of course, a bad habit of developing straight through the metal in a very short time. At the same time, Dr. Everest had called attention to the small effects of sharp corners in cast iron as compared with steel, and Dr. Becker asked for figures comparing the two materials; he had in mind a spring steel having a fatigue range of over ±40 tons per sq in., and he asked how the range for a cast iron such as Dr. Everest had mentioned would compare with it. Of course, the value for the steel would be very much lowered by sharp corners, sudden changes of section, etc., but if, as seemed likely, the figure for the cast iron were considerably less than for the steel, the effect of the stress raisers must be less deleterious in proportion.

Chilled Rolls

The super martensitic chilled rolls represented another new development, and it would be interesting to know what sort of composition would be used for a roll of, say, 12 in. dia., which was required to have a skin hardness of 800 Brinell. It had been mentioned that the hardness was reduced considerably underneath the skin, and Dr. Becker asked how far into the roll the degree of hardness developed in the skin would penetrate. He also asked whether the Izod value was low or high; even at the present time one heard a good deal about broken rolls, and one wondered whether such a hard surface would increase the chances of fracture of the material due to shock.

He had been particularly interested in heat-resisting cast irons, and a number of creep tests were being carried out at the National Physical Laboratory on various types of cast iron. These tests were being conducted at temperatures up to about 550 deg. C., and in the near future it was hoped to make creep tests at 800 deg. C. One fact which had come out of the results obtained so far was that the ordinary cast iron, and even the higher-silicon cast irons, showed rather too great a growth within the range of superheated steam temperatures; so that, although the actual creep due to load might not be excessive, yet the distortion and deformation of the iron due to the combined effect of creep and growth, very often ruled out the materials. There was a possibility of developing, either by heat-treatment or by some other method, an iron in which the growth would be sufficiently small to bring the combined creep and growth value down to within limits imposed by superheated steam plant conditions.

Heat-Resisting Irons

The heat-resisting irons proper, including the austenitic cast irons, seemed to give very promising results in the creep tests, and Dr. Becker suggested that engineers would have to make up their minds to pay the price for the nickel, chromium and other alloying elements necessary if they wished to get the very best creep results from cast iron. A point of importance which would arise was that of the stability of the iron at high temperatures. He had known cases in which, after prolonged periods at temperatures of the order of 500 deg. C., the austenitic constituent broke down; when that occurred, the creep resistance was impaired. At the same time the material might be quite serviceable at higher temperatures at which there was no tendency to breakdown, *i.e.*, where it was in a permanently austenitic condition.

Cast-Iron Crank Shafts

The BRANCH-PRESIDENT recalled that a year or eighteen months ago he had read in an American automobile paper that one of the American firms —he believed it was the Packard Company—had carried out bench tests with cast-iron crankshafts; they had made a special crankcase for the test engine, in which the bearings were $\frac{1}{8}$ in. out of centre, and in this they had run a normal forged-steel crankshaft and a cast-iron crankshaft to destruction, the results showing that the cast-iron crankshaft had 100 per cent. longer life than the steel crankshaft. He was surprised that more was not made of that in the Press of this country at the time.

The question of the cost of 36 per cent. nickel additions to cast iron had occurred to him, and he had asked Dr. Everest how he was going to persuade people to pay the price. The reply was that engineers would be so glad to have such material that they would be prepared to pay the price.

So much publicity had been given to alloy additions in cast iron that founders were constantly being asked for cast irons with additions of less than 1 per cent. of nickel and from $\frac{1}{4}$ to $\frac{1}{2}$ per cent. of chromium; the Branch-President asked if small alloy additions to cast iron were worth while, or whether Dr. Everest considered that equivalent results could be obtained with a really good, properly-made and well-controlled straight cast iron having low-silicon and, of course, very low-phosphorus contents. He personally was inclined to think that many of the alloy additions made to-day were really covering the faults of badly-melted or badly-handled iron in the ordinary foundry, rather than improving good iron.

The factor with which all founders were concerned, next to that of cost, was soundness, and he asked for Dr. Everest's advice as to the handling of the alloys in the foundry from the point of view of producing sound castings. He was inclined to think that in all the higher ranges of irons considerable difficulty was encountered in obtaining soundness—certainly more difficulty than was met with normally in grey-iron casting.

Finally, the Branch-President asked for some details as to machinability, for this was a very sore point with most foundrymen, and particularly grey-iron foundrymen; the users also would like some information on the matter. He asked that Dr. Everest would not be content merely to say that the irons referred to were readily machinable, but that he would give some actual machining speeds and data.

AUTHOR'S REPLY.

DR. EVEREST, replying to Mr. Faulkner, said he was aware that long-period sea-water corrosion tests were being carried out, but he was not sure whether any of the special irons referred to in the Paper were included in the investigation; the tests had been proceeding for some time, but the special irons had been developed only during the last few years, so that he believed they were introduced too late for consideration in that series of tests. He did not know whether it would be possible to start tests right away, but that was a matter he would consider.

Oxidation Losses

Dealing with Mr. Bartlett's question as to the methods of making the alloy additions, he said that was a matter which depended largely on the particular conditions applying in the foundry. As a general rule, it could be taken that one could add in the ladle up to about 2 per cent. of cold material such as nickel shot or ferro-chrome or silicon, provided one was using a sufficient bulk of iron for it to hold its heat, and provided foundry conditions were such that the metal had sufficient superheat to melt the addition. On the other hand, it should be remembered that happily the alloy additions usually increased fluidity. But ladle additions to small quantities of iron were not to be recommended, nor were ladle additions above 2 per cent., or where the temperature of the metal was on the cold side and one wanted to run very intricate work. In such cases cupola additions were recommended, when, of course, much depended on the method of working the cupola; for example, if one added nickel and chromium to a 10-cwt. charge in a cupola which was holding altogether some 10 or 12 charges, it was a matter of extreme difficulty to isolate the metal and to be able to say that when the tap-hole was opened one would get alloy cast iron, and he believed a good deal of the so-called losses of alloying elements were so caused. But he gathered that Mr. Bartlett was running the cupola specially for the alloy iron, and yet there were very heavy losses of manganese, silicon and chromium, whereas the percentage of nickel was increased. That seemed to point to the fact that the cupola conditions were definitely oxidising, and probably the trouble lay in this. Under no conditions would nickel be lost, because it was so stable, and he believed the apparent increase of nickel was a proportionate increase due to the loss of the other elements.

He believed the tearing effect was inherent in white cast iron as such, and he did not know that the alloys had very much influence on this property one way or the other. It was extremely difficult to make a casting such as a pump casing in white iron, and the same difficulties would arise with or without the alloys; he believed the difficulties were due ultimately to the high combined-carbon content.

The difficulty that the last tapping would not run well might tie up with the point with regard to losses, and it looked as though it was due to cupola conditions. There was nothing inherent in the type of composition which would give that trouble, but one was working with a sticky iron to begin with, and if there were a tendency to oxidise, which would make the iron more sticky, then this might prove the root of the trouble.

He was aware that the tests mentioned by Dr. Becker were being carried out at the National Physical Laboratory, but he had not referred to them in the Paper because none of the results had yet been published. But he understood that the tests were being continued, and that interesting conclusions had been reached.

Creep Values

Commenting upon the point that the creep was found to be entirely masked by a combination of growth and oxidation effects in the low-alloy irons, Dr. Everest said he had pointed out in the Paper that provided one could overcome the effects of growth and oxidation, which in cast iron were generally much greater than any creep effect, one would find that the high creep resistance would be of value. In other words, he visualised that the ideal heat-resisting cast iron would be an austenitic iron. As to the readiness of users to pay for the latter, he believed that developments had gone sufficiently far to show that where this type of material was required there was no question about the cost, because its properties were so valuable.

Dr. Everest did not agree with Dr. Becker's suggestion that vibration damping was due to internal slip. It was rather difficult to say exactly what the damping was due to, but undoubtedly this property was closely tied up with the elastic properties, and probably it was connected also with the discontinuity of the cast-iron matrix. In his view, the fact that cast iron had good creep properties suggested that the damping could not be due to any sort of slip. As Dr. Becker himself had suggested, the high endurance values were opposed to the theory that there was any degree of slip.

Chilled Rolls

It was not easy to give a definite composition for rolls, but, generally speaking, a chilled-iron base was used with sufficient alloys to give an air-hardening composition. This generally meant the addition of 4½ per cent. of nickel and 1½ per cent. of chromium. The usual method of making the rolls was to work on a standard roll mixture; then, after alloying and careful control of cooling—this was of vital importance—one could get the sort of structure mentioned.

As to the physical properties of the iron when it was made, tests had shown that the mechanical properties were much improved—they were from 50 to 100 per cent. better. But one should differentiate carefully between mechanical properties and thermal properties, because these rolls were particularly sensitive to heat effects, and had to be used with very great care.

Breakdown of Austenite

Discussing the problem of stability in austenite, and the fact that breakdown of austenite occurred at temperatures up to 500 deg. C., he said it seemed that that was a question of controlling composition. Inherently one should not get such an effect, because if the material were properly austenitic there should be no possibility of any critical points or dangerous range on heating, particularly to the higher temperatures. But there was the possibility that in a small section there might be a carbon deposition, or something of that sort. At the same time, he was fairly sure that under proper foundry conditions, and with suitable sections, the trouble should not arise, but could be overcome by a minor modification of composition.

He was grateful to the Branch-President for having recalled the test in which a cast-iron crankshaft was run with bearings out of line. He believed the reason why not very much was said about it when the results were published was that the idea of using cast-iron crankshafts was definitely revolutionary and rather shocked British engineers. He had heard of Diesel engine makers using cast steel connecting rods, and some engineers had once again been shocked; but the use of cast iron for essential parts of engines was beyond the experience of most of them.

The question of the efficacy of small alloy additions in eliminating porosity and improving properties was one which warranted a whole lecture to itself; but perhaps the best answer that he could give for the moment was that many well-known authorities in the foundry world had investigated the matter thoroughly and had proved for themselves that in practice a small amount of nickel gave a definite grain refinement and improved soundness in the castings. It was difficult to make castings which could be tested to show the effect of such small additions on porosity; porosity was so sensitive to other conditions, such as casting temperature, and so on, that they quite masked the effect of the nickel. But because it was the experience of competent workers that there was a grain refinement and greater all-round reliability in the iron when small alloy additions were used, some authorities now regularly specified nickel even as low as 0.5 per cent., although a slightly higher value generally gave more definite results.

Machinability

It was very difficult to give a definite answer to the Branch-President's question concerning machinability. The average purchaser of castings wished to machine them as quickly as possible, and was liable to accept as his standard a common iron having a Brinell hardness of 160 or so; it was difficult to persuade him that if he wanted improved strength, wearing quality or other special properties in his iron he would almost certainly have to put up with increased hardness and increased difficulty of machining. But even the special wear-resisting irons, having Brinell hardness figures such as 400, could still be commercially machined. For example, cylinder liners containing 5 per cent. of nickel had been standardised by one automobile manufacturer; he bought the castings in the as-cast condition, when they had not been subjected to any heat-treatment, and with suitable tools he roughed them with heavy cuts and subsequently took finer cuts for finishing in the ordinary manner. Machining speeds were slow, and the proper tools had to be used, but the fact that these liners were standard production with this manufacturer proved that they were an economic proposition. No material would machine castings having a Brinell hardness of 800 or 900 as in the hard white irons; they could only be ground.

The Branch-President said he had made a cast-iron crankshaft for an old Morris Cowley car of his own, and had used it until the car had become so old that it had died a natural death. When he had bought another car he had not felt so sure about fitting the crankshaft into it; but, having heard Dr. Everest's assurance that it would be quite safe to use it, he felt inclined to make the experiment in the new car.

Commenting on Mr. Bartlett's reference to alloy additions, the Branch-President said he had had a little experience of alloy additions to high duty cast iron, and had found that the only way in which to secure uniformity of composition and to avoid losses was to run the cupola with charges as small as possible and to use some type of receiver ladle into which not less than two or three—preferably three—charges were kept constantly as a reservoir of metal, and to pour from that; even in the very best cupola practice one found variations in alloy losses, and in some cases pick-ups, from charge to charge. He had even employed a balanced blast cupola, and there also one experienced variations from charge to charge. By using a receiving ladle, and having a chemist at the cupola all the time, controlling the tapping by means of a stop watch, one secured fair uniformity in the metal.

Vote of Thanks

Mr. A. S. Beech (Branch Vice-President) proposed a vote of thanks to Dr. Everest.

Mr. G. R. Webster, seconding, asked if Dr. Everest could give any information comparing cast iron and manganese bronze from the point of view of resistance to corrosion. With regard to an iron having a tensile strength of 47 tons per sq. in., referred to in the lecture, he asked what the temperature was at which it was heat-treated?

The vote of thanks was carried with acclamation.

Dr. Everest, replying to Mr. Webster, pointed out that corrosion problems depended, of course, upon the corroding media and the conditions, but, generally speaking, there was not much comparison between cast iron and manganese bronze from this point of view. Manganese bronze was definitely a corrosion-resisting material, and as such was in many cases a hundred times or more better than ordinary cast iron; on the other hand tests showed that under most conditions the austenitic irons had about

(*Continued on page 322.*)

Some Aspects of Non-Ferrous Founding

Mr. A. Logan's Paper on "Some Aspects of Non-Ferrous Founding," read before the Lancashire Branch of the Institute of British Foundrymen, attracted considerable attention.

The BRANCH-PRESIDENT (Mr. A. Phillips) referred to the question of burning-on, which was a practice which has sometimes to be resorted to in foundry work, and suggested that it was a suitable subject to be taken up by the Non-Ferrous Technical Committee with the large national buying authorities possessing inspection departments. It could be proved that burning-on was a satisfactory foundry method, worthy of acceptance. There was ample evidence that non-ferrous practice was more difficult to control than ferrous, and that when trouble occurred there was often considerable doubt as to the best way of overcoming it. The technical Press contained a formidable list of de-oxidising and de-gasifying agents, and the reader was uncertain what course to adopt. Such a list might contain phosphorus, silicon, copper, boron, soda ash, sal ammoniac, zinc, chloride, charcoal, glass, boron-carbide, etc. Could Mr. Logan outline what fluxes he used in his practice, because it was obvious that he had initiated good methods in his foundry, judging by the slides shown. What elements could be added to gun-metal and the brasses in order to render the metal more fluid or to have more life just before pouring? A further point was whether the lecturer considered that phosphorus increased the temperature of brasses in gun-metal when it was added just prior to pouring.

Sometimes metal was left in the furnaces, and became soaked, and absorbed various oxides such as copper oxides, tin and zinc oxides. Was there any way in which these could be recognised easily? If they were present, then they had to be eliminated. Another point he would like to put forward for consideration was in connection with Admiralty gun-metal, 88:10:2. Though it was deemed there had been a correct melting control associated with a correct pouring temperature at about 1,160 deg. C., it was sometimes found that there was a very porous structure. It would be interesting to learn how this could be avoided, and also what precautions must be taken to avoid this.

A further interesting point was with regard to the addition of lead to brasses and gun-metal. Did Mr. Logan consider that the addition of lead, apart from its cheapness, had any advantages in the case of gun-metal or the brasses? It would be useful, also to have information as to how to prevent segregation of the lead in very high-leaded bronze, such as 20 per cent. leaded bronze. Did Mr. Logan add iron pyrites or anything similar? De-gasifying and de-oxidising copper was sometimes a cause of trouble in copper castings, though, apparently, some people were able to make them easily. What did Mr. Logan consider was the best method of ascertaining the correct amount of silicon to add to copper to de-oxidise it and obviate the usual cauliflower top? A point which had been mentioned by the lecturer was the standardisation of alloys.

One firm, which at one time had 36 different types of non-ferrous alloys, after reviewing them with the various engineers, was able to reduce them to 14 and produce all the castings that were necessary. With regard to pouring temperature, he suggested that it would be good practice for anyone who had a pyrometer to stamp the correct pouring temperature on the board, if it were a board pattern, or on the pattern itself, for the information of the moulder. It was essential in aluminium foundry practice to have pyrometer control, and he would like to be informed as to the make of the particular pyrometer shown upon the screen; also, if there was any time lag, which was detrimental sometimes in foundry practice when using a pyrometer with a covered sheath.

MR. LOGAN stated that he purposely raised the question of burning-on because it had now reached a stage when it should be either approved or else finally discarded. It should no longer be regarded as being in any way a discreditable method. His own view was that it was a reliable process when correctly carried out with the necessary precautions. The casting should then be quite successful in actual use. The suggestion made by the Branch-President was an excellent one, namely, that the Non-Ferrous Technical Committee should place the subject on their agenda and definitely examine the process, subsequently issuing a report of their conclusions.

The question of fluxes was, of course, a point which was usually raised in a discussion relating to non-ferrous founding. His own experience was that the less one had to do with proprietary fluxes, and, indeed, the less one had to do with fluxes at all, the better. It was usually found that the flux question, like the patent medicine question, was based on fallacies. There were very many fluxes on the market in the form of proprietary compositions, and the wonderful claims which were put forward in respect to many of them could not be maintained. Personally, the only material of this kind he used was charcoal. Provided there was correct melting practice, then charcoal was the only covering necessary. Very often brassfounders experienced entirely unnecessary troubles simply through bad melting practice and incorrect or no control of casting temperature. Providing the metal was reasonably treated and raised to its correct temperature as rapidly as possible, and that it had an efficient covering of charcoal, then, in his opinion, the less one had to do with fluxes the better.

The question of the addition of other elements, of course, was quite a legitimate one. In the case of Admiralty gun-metal and other bronzes, phosphor-copper or phosphor-tin could be added as a very definite asset, and were the only additions he would make to an alloy of the bronze class. They were only made in small amounts, so that probably there was actually no phosphorus remaining in the casting at all. One did not want any phosphorus left in the finished casting, because otherwise one would finish up with a phosphor-bronze casting of gun-metal.

There was no increase of temperature with a phosphorus addition, and he thought that the impression that there was a temperature gain arose from the greater fluidity obtained when phosphorus was added. There was a certain de-oxidising effect which rendered the material more fluid. This appeared to increase the temperature, but such was not the case.

A point had been raised as to how to deoxidise metal. The runner head which had been shown on the screen was oxidised metal, though there were many stages not so apparent, from correctly melted gun-metal to one which was hopelessly oxidised. There were many degrees of oxidation, and usually the oxidised material caused porosity. It could be easily recognised by means of the microscope, but it would be very difficult, probably not even possible, to recognise an oxidised metal by merely looking at it with the unaided eye. When a section was etched and examined microscopically, the effect was immediately apparent. It was not an easy matter to get rid of oxidation, and, in his opinion, all proprietary fluxes were practically useless from that point of view. Probably the only thing to do was to use up the oxidised material in small amounts.

The addition of lead to a bronze was definitely advantageous in cases where pressure tightness was desirable. A straight Admiralty gun-metal or straight bronze without lead was notoriously difficult to get sound. An addition of 1 per cent. lead was extremely helpful, and would make a material difference in the pressure tightness of a casting. Bearing bronzes containing 20 per cent. lead were never free from segregation unless nickel was added. By the addition of nickel, which had a much higher melting point, there was a considerable increase in the rate of solidification; in other words, the material solidified before the lead had a chance to segregate.

He had not had considerable experience with regard to cupro-silicon; that is, with pure copper castings where only silicon would be allowed. For turbine work there was an alloy which was really a low-tin bronze containing 98 per cent. copper and 2 per cent. tin with a phosphorus addition. This could be cast successfully, and was virtually a copper casting. He had had very little experience of pure copper castings as such, except that cupro-silicon could be added, and that boron-copper was quite a good addition.

He was very glad to have the Branch-President's confirmation of the necessity for standardisation, which was a consummation long overdue.

The reduction of 36 alloys down to 14 had been mentioned. If a system of standardisation was adopted it might be possible to reduce, say, the 36 alloys down to six or eight, and everything could be done that had been done previously with the 36. One had only to produce such a variety of alloys of that kind to realise the difficulties of checking the composition and the returns of heads, runners and borings, to realise what an unnecessary expense was involved.

The suggestion that the correct casting temperature might be put on the pattern was a very good one. He was, personally, trying to evolve a system whereby all such features were marked on the pattern; namely, the finished weight, the weight of the article as-cast, the correct method of gating, and the casting temperature. The next time the same pattern came to the foundry to be cast all the necessary particulars would be seen at a glance. It would be realised that a pattern successfully cast six months previously might return again to the foundry, and, due to changes in personnel, a different set of moulders might have to deal with it and find out what were the correct conditions for that particular pattern. Once a pattern had been correctly cast, then all details of that kind should be put upon the pattern so that there should be no question about the right method of dealing with it in future.

The pyrometer shown on the screen was in a sense "home made." It was evolved in the laboratory to meet the conditions of the foundry. For a long time the foundry could not put any continuous system of temperature control into operation because of the difficulty of finding a pyrometer which would do the job satisfactorily. The instrument which had been shown was definitely practical and could be put into use for long periods without trouble. The average number of immersions per sheath was 165, including breakages from all causes, and in some cases they obtained as many as 260 immersions. There was not a great time lag. The silica sheath was 2½ mm. thick. The plumbago coating did not give a very great lag, so that it was quite a practical operation to insert it in every crucible and take the temperature. The method was that the furnace man indicated when he thought the temperature was within about 50 deg. of the correct point. The time taken to bring the pot to the required temperature was known; so there was no question of the time lag affecting the metal or letting the metal get too hot. (This was illustrated by a short film.)

MR. J. A. REYNOLDS (Prescot) suggested that a system which he saw described some years ago for recording the various factors for the control of the casting process would probably be better than the attempt to mark the pattern. If the pattern

was a small one it would be exceedingly difficult to make it into a catalogue. It would be difficult to show, on a pattern, the type of runner. It might be possible to indicate its position, but be difficult to show whether it was horngate or flatgate or was given a check in the down gate, or even indicate the height. The system he referred to was used in connection with aluminium castings. A card index was used and in some instances a little sketch was included showing the history of the casting, and sometimes even a history of one or two unsuccessful attempts.

With regard to the question of oxidation, the fact should not be lost sight of that metal could also fail by being melted in a too strongly reducing atmosphere, particularly when oil firing was used.

In many instances engineers, in their specifications and contracts, recognised burning-on, but stipulated that special permission must be obtained in all cases.

MR. LOGAN, in reply, said, where oil firing was in operation, it was a very definite practical point that castings could fail by being melted in a too strongly reducing atmosphere. The trouble was largely due to the solution of hydrogen in the metal, with, possibly, carbon monoxide also. The effect would be, generally speaking, to produce a gassy metal which would show unsoundness due to gas bubbles occurring at the moment of solidification similar to the trouble experienced when metal was poured into a damp ladle.

MR. REYNOLDS inquired what was the best method for removing large risers from non-ferrous castings. He believed chippers were being used for aluminium, but he had not seen them advocated for non-ferrous metals generally. Was it better to use a band saw or a hack saw?

MR. LOGAN said some castings were too big to put under a band saw, while in other cases a runner would be more easily removed if simply nicked through and broken off. It was rather a slow operation to use a band saw under some circumstances, and he was under the impression that the greater proportion of the work done in the foundry with which he was connected were nicked and then broken off with a sledge hammer. This did not, perhaps, seem particularly scientific, but it was rapid and cheap. A git-cutting machine was also used.

MR. J. JACKSON said that he had experienced trouble with a casting which was in the shape of an ordinary dumb-bell used for physical-culture purposes. The casting was about 5 in. long, 2½ in. dia., and reduced in the centre like a dumb-bell. The casting worked in a lignum-vita step in water, and after two years' service, owing to excessive wear on the particular metal used, another metal was substituted, which certainly stood up to wear remarkably well. The metal now being used was 84 copper, 3 lead, 8 tin and 5 per cent. zinc. The castings originally made were cast in the horizontal position. For facility and cheapness of machining it was found better to cast as a solid block vertically, running from the bottom, then cutting out the neck. Excellent castings were obtained in that manner. With the metal now used it was possible to cast horizontally and get a perfect casting, but it had not been found possible to get a perfect casting vertically as there were small indents.

MR. LOGAN replied that without knowing further details and cutting sections and examining specimens under the microscope he could not hope to throw much light upon the particular point. He suggested that if Mr. Jackson made his casting in the vertical position, with an extra head which could be cut off, he might get rid of the sponginess in the centre.

MR. JACKSON said he cast some stocks 30 in. long, and cut the top part away, but the trouble was still apparent. When cast horizontally the percentage of wasters over many thousands was something like 1½ per cent., covering the whole foundry and moulders' faults. In the other case it was no better than 50 per cent. at present. The cost of machining was exactly half when reducing from the stock. They were continuing the casting horizontally, but because they had cast all the others vertically and saved so much in machining, he wanted to continue with that saving.

MR. SUTCLIFFE asked whether Mr. Logan thought non-ferrous castings could be made successfully by using a small cupola operated at a very low blast pressure. Many brass moulders disliked oil-sand cores on account of the metal eating into them. He would be pleased to learn if a suitable mixture could be suggested.

MR. LOGAN said that successful moulding depended upon the correct utilisation of scientific principles. If the moulder did not get correct results, it would be because he was not using correct principles. Therefore, by producing a sound casting was applying correct principles whether he was aware of it or not.

Cupola melting for non-ferrous work might be possible. He had heard of cupolas being used for copper melting and copper production. He would like to have a chance of investigating the matter further if possible.

When he first adopted oil-sand cores in the foundry he was met with the suggestion that they would not be satisfactory, though personally he thought they should be. When he came to investigate the matter he found that where trouble had been experienced in respect of oil-sand cores in non-ferrous work it had been invariably due to the fact that too coarse a sea sand had been used. His present practice was to use a fairly fine sea sand without any further additions other than the core compound. He could not remember having had any trouble with badly-shaped cores or metal eating in. With sections of 3 or 4 inches thick, surrounding an oil-sand core there was a roughness on the inside due to the excessive heat having burned out the bond, but when it was trimmed off it was unimportant. The sea sand that he used was the Seaton Carew blown sand.

MR. SUTCLIFFE inquired what difference there would be by using half Mansfield and half sea sand.

MR. LOGAN thought that probably some of the inherent benefits of the oil-sand core would be lost; there would be a closing up of the core. There would probably be trouble due to impermeability. By using fine sea sand, free from any loam addition, the porosity was retained. If the core boxes were lightly rammed there was not likely to be any trouble.

MR. J. S. G. PRIMROSE (Manchester) said there was definitely a great advantage in the use of lead in resisting the effect of steam in lowering the strength of gun-metal.

At the conclusion of the proceedings the BRANCH-PRESIDENT, Mr. A. Phillips, drew the attention of the members to the service which was given by the various technical sub-committees by supplying confidential answers to any problems posed. The committees included many men of high eminence in the various phases of castings manufacture.

Vote of Thanks

MR. W. NORMAN COOK, Senior Vice-President of the Branch, proposed that a very hearty vote of thanks be accorded to Mr. Logan for his extremely interesting communication, saying that it was only occasionally that the subject of non-ferrous founding was discussed by the members of the Branch. He agreed with most of the statements contained in the Paper, and particularly so with regard to the troubles experienced by small foundries in respect to non-ferrous founding.

MR. W. H. MEADOWCROFT (Burnley) seconded the vote of thanks, remarking that Mr. Logan had been very courageous in talking about wasters and in placing foundry people all upon one level.

The vote of thanks was carried unanimously by acclamation.

MR. LOGAN, in responding to the vote of thanks, was of opinion that to thank the lecturer before the conclusion of the discussion was somewhat in the nature of counting one's chickens before they were hatched. Very often the discussion was the most valuable part of the proceedings.

M. Eugène Schneider

M. Eugène Schneider, who is chairman of the Société du Creusot, and associated with other large concerns throughout Europe, has been elected to the seat in the Académie des Sciences morales et politiques, left vacant by the death of M. Louis Lépine. It will be recalled that M. Schneider, after the war, was faced with the problem of adapting the Creusot Works to new conditions, and, thanks to the renovation of the equipment and to a new adjustment of methods in relation to modern economic necessities, his firm has maintained its position as a leader in European industry. He acquired a considerable interest in iron and steel concerns in Luxemburg and in Central Europe, and also in several iron and steel works and engineering concerns in France. Thanks to the organisation set up, in which various plants and departments specialise in certain directions, and thanks also to the commercial organisation which pushes its ramifications in the principal countries of the world, the Etablissements Schneider have accomplished the feat of following a unified industrial policy over all the interests which the concern holds. M. Schneider was President of the (British) Iron and Steel Institute from 1918 to 1920. At the end of 1919 he was appointed, by the French Government, chairman of the Economic Mission which was sent to the United States at that time. He was awarded the gold medal of the Mining and Metallurgical Society of America, and made an honorary member of the American Iron and Steel Institute. He holds the degree of Doctor of Science of the University of Pittsburgh, and was given the Freedom of that city. He holds the John Fritz medal, and has been awarded the Bessemer medal by the British Iron and Steel Institute. M. Schneider's hospitality will be recalled by members of the Iron and Steel Institute on the occasion of its visit to Czecho-Slovakia a few years ago.

Potentialities of Cast Iron

(*Continued from page* 320.)

the same order of resistance as manganese bronze or an ordinary phosphor bronze; the austenitic cast iron being about 100 times better than ordinary cast iron, for example, in weak sulphuric acid or weak hydrochloric acid.

All particulars of the heat-treatment of high-tensile iron were given in the Paper by Piwowarsky, published in the Transactions of the I.B.F., 1927-28.

Commenting further on the use of cast-iron crankshafts, Dr. Everest said he believed that when the Americans used cast iron for that purpose they definitely designed for it; he did not think it was possible to use an ordinary steel shaft as a pattern for making a cast-iron shaft. Finally, he said he would accept no responsibility whatever for any experiments which the Branch-President might carry out.

(*To be concluded.*)

NEGOTIATIONS HAVE BEEN CONCLUDED whereby General Refractories, Limited, of Sheffield, have acquired the business of Messrs. J. Hinchliffe & Company, Bullhouse Colliery and Ganister Works, Penistone, Sheffield.

West Yorkshire Annual General Meeting

The annual general meeting of the West Riding of Yorkshire Branch of the Institute of British Foundrymen was held on April 28 at Bradford Technical College, under the retiring Presidency of Mr. R. D. Welford (Bradford).

MR. S. W. WISE (hon. secretary), of Bradford, presenting the Annual Report, said it was gratifying to note that in spite of the industrial depression in the West Riding area—a depression which had not yet completely lifted so far as concerned the foundry industry—the Branch was holding its own in regard to numerical strength, and was most certainly making progress in the potential resources of the Branch and the usefulness of its work for the members and the industry. The attendance of members at the various meetings and works visits during the past year had been above the previous average, and interest and enthusiasm remained unabated. The Branch had kept in mind the defined objects of the Institute, and with this end in view Papers had been given on subjects of more than usual interest—including porosity, foundry costs, machine moulding, the foundry from a patternmaker's viewpoint, and the technical training of foundry apprentices. In addition, a visit had been paid to one of the largest works in the district. The average attendance of members of the Council at the meetings had been remarkably high, and it was felt that the consistent support given by Past-Presidents had been a source of strength and encouragement to the work being done in the West Riding.

One very noticeable feature of the meetings, continued Mr. Wise, had been the increasing number of the members taking part in discussion. This, he suggested, was an aspect which should be encouraged to the utmost, and a channel towards this end might be by a wider invitation to members to contribute short Papers—two or so in an evening. The Technical Library of the Branch retained its interest among the members. The Principal of the Bradford Technical College was the very good friend of the West Yorkshire Branch, and members of his staff were always ready to help with lectures and Papers. The Branch was under a debt of gratitude to the Bradford Educational Authorities for the use of the College for their meetings and for the housing of the Technical Library.

Although assured of the unfailing support of their own members, the hope was repeated—as frequently expressed on previous occasions—that more foundry proprietors and principals of engineering firms in the district might take an active part in the work of the Institute than had been the case hitherto. The Institute, through its members has done more than any other agency to bring British founding to its present high standard, and although during the past sessions they had felt an increased support from employers, they looked for a still more marked and valued interest in its activities from that direction.

The report, together with the statement of accounts (also presented by Mr. Wise), was adopted on the proposition of Mr. H. Sayers (Leeds).

Apprentices and Education

Lengthy discussion arose on the subject of the difficulty of developing the technical classes in the districts, owing to the scarcity of students. Mr. Wise said the Institute and its branches were being magnificently supported by the educational authorities in the foundry districts by a willingness to provide tuition if the requisite number of students were forthcoming. Developments in the Institute on the technical tuition side, indeed, had been such in recent years that one was sometimes inclined to wonder whether a section of the Institute had not been going a little "education mad." They had had the Craft Certificate scheme. They had the project for a degree in foundry practice at Sheffield University, and now they were informed of the plan for classes specially aimed to attract the man from the foundry floor, but the great difficulty seemed to be the lack of students.

MR. A. S. WORCESTER (Huddersfield) said, to his mind, the general state of craftsmanship in the foundry industry at present was rather appalling. The Institute had done a great deal of foundation work, but it needed the support of the young men themselves if it was to produce the higher standard of craftsmanship which was called for by modern engineering requirements.

Answering comments on the success which had been achieved by the foundry technical classes at Huddersfield, as distinct from other districts in the West Riding area, Mr. Worcester said it was due to persistent effort on the part of men keenly interested in the future of the craft. Young men were the same everywhere, and much depended on the personal efforts of the seniors in the locality. The maintenance of interest was very largely a matter of interested personal contact on the part of seniors.

MR. H. HOLDSWORTH (Denton) said he saw no reason why the attention of those interested in technical education in the foundry industry should be concentrated especially on apprentices. There were, he believed, a good many young men from 21 to 25 years of age or more who could very well do with some further craftsmanship training, and he saw no reason why they should not be urged also to join classes.

The CHAIRMAN said he was quite sure the technical education authorities would be quite glad to welcome youths over the usual "apprentice" age. There had, indeed, been tuition given to youths over the apprentice age—even, to his own personal knowledge, into the age of thirty and over. The reference to apprentices was chiefly because the apprentice was at a period in life when technical education was inclined to be a matter calling for some outside encouragement in the lad's mind.

On the proposition of MR. WORCESTER (Huddersfield), seconded by MR. J. J. WATSON (Huddersfield), the meeting passed a resolution authorising the appointment of a special Educational Committee of the West Riding Branch of the Institute, with a view to promoting personal contact with the young men in the foundries in the various districts of the Branch area. At a subsequent stage of the meeting—after the election of the Branch officers and Council—the following were appointed the Educational Committee for the coming year:—*Bradford area*, Messrs. W. G. Thornton, George Hall (of Shipley) and H. A. McColl (Bradford Technical College); *Leeds area*, Mr. H. Sayers; *Huddersfield area*, Mr. A. S. Worcester; *York area*, Mr. J. W. Blair; *Halifax area*, Mr. W. Parker; *Wakefield area*, Mr. John Haigh and Mr. Walter Fearnside; with power to add four consultative purposes or as otherwise felt desirable.

The Branch Officers

The following were appointed to Branch offices for the ensuing year:—President, Mr. A. W. Walker (Huddersfield); Vice-Presidents, Messrs. F. K. Neath (Keighley) and G. Hall (Shipley); hon. secretary and treasurer, Mr. S. W. Wise (Bradford), who on re-election was the subject of warm tributes by the past and new Presidents and other speakers; added to Council, Messrs. N. W. Riley (Harrogate), H. Holdsworth (Denton) and G. Copeman (Leeds), for three years, together with Mr. H. A. McColl, of Bradford Technical College, to fill a vacancy for two years arising from the elevation of Mr. Walker to the presidency.

The auditors, Messrs. Thornton and Hall, were re-elected, and Messrs. F. Squires (Bradford) and H. Bradbury (Huddersfield) were elected joint librarians and registrars in the place of Messrs. S. F. Wise and G. E. Booth, who had asked to be relieved. Messrs. A. S. Worcester (Huddersfield) and F. K. Neath (Keighley) were reappointed Branch representatives to the General Council of the Institute, and warm tribute was paid to their work on that body and on the Technical Council.

MR. WORCESTER, responding to these expressions of appreciation, said the work involved a good deal of travel and time, but he wished to speak particularly of the specially extensive expenditure of time and effort by Mr. Neath as a member of the Furnaces Sub-Committee. The Technical Committee as a whole was undoubtedly doing a very valuable service to the industry, but very high credit was due in particular to men like Mr. Gardner, Mr. Neath, Mr. Hirst, Mr. Russell and the others so closely associated with the scientific and research side.

MR. NEATH said Mr. Worcester was unduly modest as to his own part in the work of the Technical Council. The scientific aspect of affairs needed, and received, an invaluable backing in putting its efforts into practical effect by the practical men, of whom Mr. Worcester was one of the most enthusiastic.

Iamzite

NEW ALLOY CAST IRON

The unsuitability of ordinary cast iron for certain castings is common knowledge. It fails to stand the test of intense heat, it is neither non-corrosive nor non-magnetic, it grows and it scales. There would therefore seem to be a wide field of usefulness for the castings made by John Williams (Cardiff), Limited, of Cardiff, from their alloy cast iron, which they have christened "Iamzite."

The new alloy, whilst possessing all the advantages of ordinary cast iron in moulding and machining, is for all practical purposes heat-resisting, non-corrosive and non-magnetic; growth and scaling are also negligible. It is intended for use in all castings which are required to resist intense heat, to withstand corrosion, and which should be non-magnetic. The alloy may be varied to meet any one, two or all three conditions. Such castings would include furnace parts, firebars, doors, skid bars, annealing pots, carburising and tempering boxes, ingot moulds, hydraulic parts, pump barrels, plungers, liners, etc., whilst its non-magnetic properties suggest innumerable uses in the electrical and kindred industries.

Apparently, considered in relation to its special properties, the material is not expensive. Naturally the price is determined by the quantity, size, weight, design, and the particular use for which the castings are required. It must be remembered that the alloy constituents are adjusted to meet the special requirements of the particular duty. We understand that the prices for a machinable alloy range from 5d. per lb. upwards, but unmachinable alloy castings can be made to withstand heat and corrosive attack at a much cheaper rate.

The appended tests are distinctly interesting, though they are merely comparative; it is not suggested they are absolute.

Corrosion Test to Compare Iamzite (Machining quality) with Ordinary Cast Iron

The following tests in acid solutions show the percentage loss of weight for machining-quality "Iamzite" and (ordinary cast iron) in 20 per cent. acetic, 1.2 (16.2); 5 per cent. hydrochloric, 0.98 (12.2); 5 per cent. sulphuric, 1.36 (12.7); and mine water, 0.12 (0.33). The size of the specimen was ¾ in. dia. by 1½ in. long. These test-bars were tested in the reagent and in the atmosphere alternately.

Production Costs and Selling Prices

By W. A. Hodson, A.C.I.S.

(*Concluded from page 298.*)

Fluctuating and Fixed Costs

By an illustration (Fig. 2) the effect of fixed charges on costs is clearly shown. In the earlier part of this Paper it was mentioned that fixed charges are those charges which do not rise or fall with the output. They remain constant whether the foundry is producing at full capacity or only part capacity.

The figures charted represent a hypothetical case of a steel foundry working at 90 per cent. capacity. It will be seen that the fluctuating costs start from zero, and give a total fluctuating cost of £57,000, for an output of 1,350 tons, which is equal to 90 per cent. of the total capacity during the period. This fluctuating cost line should reduce proportionately to the output. On the other hand, the fixed charges, whilst remaining constant, do fluctuate the cost considerably. At 90 per cent. capacity the fixed charges increase the fluctuating cost by £3 per ton, at 80 per cent. capacity the cost is increased by £3 8s., at 70 per cent. capacity by £3 18s., at 60 per cent. capacity by £4 11s. and at 50 per cent. capacity by £5 8s. per ton.

The fixed charges are estimated at the beginning of a period according to the liabilities which it is known will be incurred. Though the tonnage may be small, the fixed charges during the period will remain the same, and consequently this charge runs parallel with the fluctuating cost for the whole period.

In the illustration the sales are shown by the dotted lines starting from zero and running to £65,000. It will be noted that this line crosses at the 700 tons point. This is the point at which losses end and profits begin. Below an output of 700 tons for the period on the same total cost figures means a dead loss, because the total cost is not being covered by the selling price. Above 700 tons the value of sales increases with the higher output, and the difference between total cost and total sales being the profit, the margin as shown, gradually increases, providing, of course, that the average selling price per ton is not seriously reduced.

Waster Castings

Wasters have a very serious influence on costs, and it is not generally appreciated how serious they are. Every waster casting, mould or core, increases the cost by the production cost of making a replacement, the loss in production and the wasted time.

For example:—A core taking ½ hr. to produce is scrapped, the assumed wages are 9d. and oncosts 9d., the cost of that core is 1s. 6d. and the cost of a new one 1s. 6d. The cost of the core is, therefore, 3s.

A casting is scrapped before fettling. The assumed rates are: coremaking and moulding 1s. 6d. per hr., oncosts 1s. 6d. and 1s. 3d.

	s.	d.		s.	d.	s.
Coremakers' wages ½ hour	0	9	Oncosts	0	9	
Moulders' wages, 2 hours	3	0	,,	2	6	
Metal, 2 cwts.	9	0				
	12	9	Plus	3	3	= 16
A new casting will cost						16
Add fettling cost, say ..	1	0				
And oncosts	1	0				
						2
THE PRODUCTION COST OF THE CASTING IS ..						34
THE CASTING SELLS FOR 10S. PER CWT.						20

The profit on the job should be have been 4s., but the result is a dead loss of 14s.

The obvious conclusion to draw from such an illustration is that it is not only the direct cost of making a casting, but the overheads incurred in making the waster, and the loss in production which are vital, and an absolute minimum scrap must be kept if costs are to be below selling prices. The average scrap percentage of a shop is often considered, but more important is the scrap on any particular orders, the average on the total output may not be a very serious item, but the effect on the cost of individual jobs is shown in the final summary. Scrap means productive time being turned into non-productive time.

Normal Overheads

The foundry industry, due to its character, is subject to greater extremes in production than most other industries. There are periods when the demand is equal to the entire productive capacity of the foundry, and other periods when only a small portion of the capacity can be utilised. Such periods are a source of considerable worry.

As is known, it is not always what a casting costs but what it is worth to the purchaser that

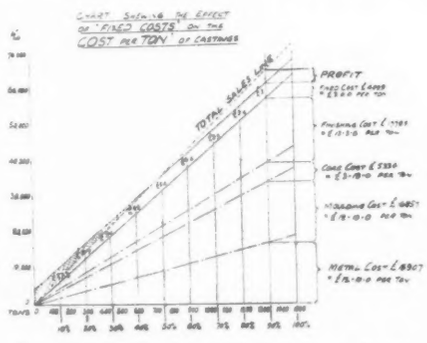

FIG. 2.—SHOWING THE INFLUENCE OF FIXED COSTS ON COST PER TON OF CASTINGS.

determines the selling price, and, as Henry Ford says, "He takes what people would pay for his product and not the cost of production as the basis for fixing prices. It is the process of buying fairly and with the smallest possible addition of costs transforming these materials into a consumable product."

Business to-day is highly complex. It is conducted on knowledge and the interpretation of facts. There is nothing easier than to get prices down, but it is more difficult to get them up again. Production costs can be controlled, the fixed costs are stationary, and during both normal and abnormal times the production costs and value of production per £ of wages paid, are of equal importance.

Rapidly diminishing orders are the first effect of bad times, men are paid off, purchases are curtailed, but expenses do not necessarily diminish proportionately to volume of work passing through the shops.

It is during times of depression that the correct costs obtained during normal periods are of particular value. It is unreasonable to expect a customer to pay an increased price for castings when the foundry costs are high due to low production. Correct costs are not necessarily a hard and fast basis for the fixing of selling prices, but they are a guide in times of depression. The profit which may be made under normal working conditions will be forfeited in abnormal times, and during such times the question to answer is, "At what price can orders be accepted so that the loss entailed will be less than the loss that would be made through not having the business?"

Costing in any form will not change economic laws, nor will it make buyers willing to pay a higher price because the calculated cost is a higher figure than selling price. It does, however, enable the seller to fix prices which will attract the buyer and enable the total losses to be reduced. Regular preparation of costs will give an indication of the position of the profit and loss account.

A normal overhead rate is one which is taken over a normal period, and will absorb the expenses of that period—a rate based on normal conditions of production and expense.

Periodical Cost Report

So far the author has discussed principally job costs, but he must make mention of periodical-cost reports, monthly or quarterly, as circumstances dictate. Monthly reports are helpful, but usually quarterly reports prove of greater value, the figures are more complete and take into account expenditure which must be spread over a period. Such reports should give information which can be of use, often reports of this type contain useless information, as, for example, figures which are carefully worked to three places of decimals on minor items, etc.

Assuming that the usual forms of charge sheets are in use, or stocks carefully checked, and it is known the weight of metal, coke limestone, stores, etc., used, the first detail of the report will show:—

Weight of metal charged.
Weight available for casting.
Total weight of castings sold.
Total weight of castings for own use.
Stock of castings in progress at beginning of period.
Stock of castings in progress at close of period.

Periodical stocktaking is essential for correct costs; without this figure correct output figure cannot be obtained.

Increase or decrease in stock.
Total output of good castings.

Following this will be details of the production cost of each section of the foundry, with the cost per ton of production of each section.

The fixed charges may be included in the departmental costs or may be added as a separate item in the final cost. It is certainly preferable to leave fixed charges out of the shop cost; these charges are not the responsibility of the shop, their control is in the hands of the management, the fixed charges are outside the shop control.

With information concerning the cost of castings coming within certain classes or weight ranges, together with the total production cost over a period, the condition of the shop can be fairly accurately judged, and this brings in the interesting subject of a budget. It is a word now commonly in use, but how many business men look to the help of a budget to plan the activities of the future? Certain American industrialists have given much thought to expenditure by budget—whether they have succeeded in attaining their ambitions it is difficult to say.

The Budget Question

One author took the basis of his budget, the data obtained from the Foundry Manufacturing and Profit and Loss Account for the previous working year, and the figures were prepared to show the actual expenditure of each department. The result showed that the profit for the year was just sufficient to give a return of 3¼ per cent. on invested capital, which was certainly running dangerously close. The output represented an operating rate of 65 per cent. of sales capacity. Had the total sales been high enough to enable the foundry to work at 90 per cent. capacity, the profit would have been nearly three times greater.

(*Concluded on facing page.*)

This Week's News in Brief

Trade Talk

THE BRITANNIA LEAD REFINERY at Northfleet has resumed operations.

THE BLAST-FURNACE at the works of the Brymbo Steel Company, Limited, Denbighshire, has been relighted.

THE FIRST MOTOR-CAR to be manufactured in Yugo-Slavia was recently turned out of the Ljubljana Works, which were established last year.

MESSRS. WILLIAM BEARDMORE & COMPANY, LIMITED, Parkhead Forge, Glasgow, have received an order for 1,000 sets of wheels and axles for the Indian State Railways.

AN ORDER has been placed in this country on behalf of the Spanish Mint for 21 tons of Mond nickel, which will be used in the manufacture of 3,000,000 pesetas' worth of 25 centimos coins.

THE MOULDERS who went on strike at Messrs. Glenfield & Kennedy, Limited, Kilmarnock, as a protest against the new regulations about three weeks ago have now returned to work.

THERE HAVE BEEN some large imports of iron ore into Grangemouth during the past week, including 9,000 tons from the new orefield in Sierra Leone, 6,900 from Oxelsund and 3,000 from Narvik. A total of 30,000 tons has been brought in during the week.

A SEVEN-MILE-LONG ROPE for the Glasgow Subway Railway haulage system has just been delivered from the Rutherglen works of British Ropes, Limited. The rope is probably the last which will be required for the subway owing to the impending electrification of the system. The rope weighs approximately 57 tons.

SIR WILLIAM ARROL & COMPANY, LIMITED, Glasgow, have received contracts for one 20-ton overhead electric travelling crane, one 10-ton trolley hoist, two 5-ton trolley hoists, and one 1-ton and four 70-cwt. pulley blocks, all required in connection with the new extension of the power station of the Metropolitan Borough of Fulham.

THE DIRECTORS OF Messrs. Herbert Morris, Limited, manufacturers of lifting and transporting machinery, propose to return the whole of the £100,000 of 6 per cent. preference capital to holders of the shares in cash. If the repayment is approved the issued capital will amount to £500,000, divided into £200,000 of 5 per cent. preference and £300,000 of ordinary capital.

MESSRS. McKIE & BAXTER, LIMITED, Paisley, have received an order for the construction of a tug and teak log carrier for service in India. The firm will build the machinery, but the hull will be built by Messrs. Ardrossan Dockyard Company, Limited. Messrs. McKie & Baxter have a large amount of work on hand and a 24-hr. day has been in operation for some time in their works.

WITH A VIEW to encouraging the maintenance of oxy-acetylene cutting equipment ready for use in emergencies, where victims of fires and accidents are trapped by metal work, the British Oxygen Company, Limited, London, has arranged a special demonstration of B.O.C. oxy-acetylene cutting equipment at the forthcoming Eastbourne Conference of the Professional Fire Brigades Association.

Production Costs and Selling Prices

(Concluded from facing page.)

With this information he set out to prepare a new formula, *i.e.*, sales, minus the sum of profits desired, plus fixed costs, equal manufacturing costs. This substituted the old formula, sales minus cost equals profit. In the preparation of the budget the first task was to make a careful estimate of sales, a calculation of the profit desired and an examination of all cost elements to see what reductions in expenditure could be effected. Costs were then limited to certain amounts and the cost of production must not exceed this amount.

The Chancellor of the Exchequer makes a budget and this year has a nice credit balance; perhaps if foundrymen would budget their expenditure and keep to it the losses so much talked of would just as easily prove to be a credit balance to profit and loss account. It is worth trying.

THE ELECTRIC WELDERS who had been on strike are returning to work at Messrs. Yarrow & Company, Limited, Scotstoun, and Messrs. Harland & Wolff, Limited, Govan, Glasgow, on piece-work. The employers had introduced a time rate of £3 per week, which the men said meant a loss of £1 to £1 10s. per week. It is expected that the strike will be settled in the other yards on the same basis.

THE SCOTTISH iron and steel manufacturers have been asked by the British Federation of Iron and Steel Manufacturers' Executive to agree to a new quota scheme of production for Scotland. The Scottish manufacturers are to be allocated a quota which will mean a considerable increase on the present aggregate production, but will be less than the peak output before the war. If the scheme is approved, it is expected that arrangements will be made whereby pig-iron and other materials imported from England will be produced in Scotland. This will be offset by a restriction in the Scottish export trade. The scheme is now under consideration by the Scottish producers, who have to make their decision within a month. The iron manufacturers were opposed to the scheme, as they believe it would be much better for Scotland to have a free hand. It is possible that certain plans of development will be held up until the scheme is settled.

IT IS OFFICIALLY ANNOUNCED by Messrs. Colvilles, Limited, Motherwell, that they have purchased the large steel plant of Messrs. William Beardmore & Company, Limited, at Mossend. The plant has been idle for the past six years. It is feared that this means the end of Bellshill district as a steel-producing centre. Messrs. Colvilles intimate that there is little hope of the plant going into active production, though certain portions of the works may be utilised in time. It is expected that the works will be dismantled as a contribution to the scheme of rationalisation now going on in the steel trade. The Clydesdale steelworks are only a few hundred yards away from the Beardmore plant, where the universal mill shut down at the New Year is now almost completely dismantled. The only steelworks now in operation in the district is the Milnwood plant of the Colville combine, which re-rolls steel made elsewhere. The works have been busy for some time turning out material for Russia.

Company Reports

Steel Company of Canada, Limited.—Quarterly dividend of 30 cents on the common shares.

International Nickel Company of Canada, Limited.—Dividend on the common shares of 10 cents.

Brush Electrical Engineering Company, Limited.—Accounts for 1933 show a deficit of £85,681, which has been charged against general reserve.

New Companies

Watford Foundry Company, Limited, 164-167, Temple Chambers, Temple Avenue, London, E.C.4.—Capital £10,002. Directors: W. A. S. Oxborrow and E. Holloway.

International Bath Association, Limited.—Capital £1,000; 1s. shares. Directors: G. K. M. Benteler, H. Bosse, O. B. Clausen, L. K. A. Hanstein, T. A. McIntyre, W. Mathieson, jun., G. Pate, A. W. Steven. Solicitors: Clifford-Turner, Hopton & Lawrence, 81-87, Gresham Street, London, E.C.2.

Contracts Open

India, May 31.—Locomotive parts, for the North Western Railway. The Department of Overseas Trade. (Reference G.Y. 13,783.)

Johannesburg, June 21.—Twenty-one ornamental street-lighting poles, for the City of Johannesburg. The Department of Overseas Trade. (Reference G.Y. 13,801.)

Bekesbourne, May 28.—Supplying and laying about 363 yds. of 3-in. water main, with fittings, for the Margate Town Council. Mr. E. A. Borg, borough engineer and surveyor, 40, Grosvenor Place, Margate.

Personal

THE TRUSTEES OF Battelle Memorial Institute, Columbus, Ohio, announce the appointment of Mr. Clyde E. Williams as Director of the Institute and Dr. H. W. Gillett as chief technical adviser.

MR. AND MRS. JAMES DOUGAN, of 6, York Street, Ayr, have celebrated their golden wedding. They were married on May 4, 1884, and Mr. Dougan, who is 75 years of age, was for over 30 years in the service of Messrs. William Baird & Company, Limited, now Bairds & Dalmellington, Limited, but two years ago he met with an accident which incapacitated him for work.

Obituary

MR. JAMES CALDER, who was for many years in the employ of the Coltness Iron Company, Limited, died last week at the age of 53.

MR. STANLEY G. FLAGG, JUN., eleventh President of the American Foundrymen's Association, has died at his home in Philadelphia, at the age of 74 years. Mr. Flagg, President of Stanley G. Flagg & Company, Inc., Philadelphia, was born in the city of Philadelphia in 1860, and at 18 years of age entered the employ of Stanley G. Flagg & Company, having received his education in the local private schools of Philadelphia. He contributed greatly toward the building-up of the company, and on the death of his father, Mr. Stanley G. Flagg, became senior partner. When the partnership was dissolved and the company incorporated, he became its first President. In addition to his connection with the A.F.A., Mr. Flagg was a member of the Iron and Steel Institute, as well as many American societies, and he was an honorary member of the Institute of British Foundrymen, which he joined three years after its foundation in 1904.

WE SINCERELY REGRET to announce the death of Mr. S. T. Johnston, at his home in Riverside, Illinois, on April 23. Mr. Johnston was the twenty-eighth President of the American Foundrymen's Association, serving in that capacity during 1928 and 1929. Probably there was no one who enjoyed a wider acquaintance or was more popular in the foundry industry than Mr. Johnston. A native of Glasgow, he went to America in 1889, his first connection being with the Detroit Car Wheel Company. Later he went with the Whiting Foundry Equipment Company, now the Whiting Corporation, and continued with that organisation for several years. He then became connected with the S. Obermayer Company, and served that organisation continuously until he retired in 1932, at which time he was Vice-President. Mr. Johnston early became identified with foundry association work, and in 1896 was elected secretary of the Western Foundrymen's Association. As an officer of that organisation he was one of the signers who called a meeting of foundrymen at Philadelphia in 1896, which resulted in the formation of the American Foundrymen's Association. A charter member of the A.F.A., he had attended every annual convention except that of 1932, when illness intervened. He became one of the first directors, and served continuously for eight years. In 1927 and 1928 he again served as Vice-President of the Association and in 1929 as President, distinguishing himself as a leader with the A.F.A. group of delegates attending the third International Foundrymen's Congress held in London, June, 1929. As President of the A.F.A., he served as chairman of the International Committee of Foundry Technical Associations, and presided at their meeting during the London Congress, and on that occasion made many friends. When the Foundry Supply Association was organised in 1906, he was elected the first President. He was also closely connected with the development of the Foundry Equipment Manufacturers' Association, serving as its President in 1926. Mr. Johnston had resided at Riverside, Ill., for the last thirty-three years, where he was very active in community affairs. For nine years he was a member and President of the Riverside Board of Education, President for two years of the Riverside Golf Club, and at the time of his death was President of the Riverside Public Library. In his passing, the A.F.A. and the entire foundry industry loses one of its best-beloved members and fellow-workers.

Raw Material Markets

Satisfactory conditions are maintained in the iron and steel markets, producers in most branches being well booked forward. The demand, however, is still mainly from the home trade, export business being hampered by the import restrictions and currency difficulties met with on the Continent. The problem of the export trade will be one of the first matters to be considered by the newly-constituted Iron and Steel Federation.

Pig-Iron

MIDDLESBROUGH.—The entire output of Cleveland pig-iron is moving away into consumption, and, stocks being low, any increase in the current demand would necessitate the re-starting of an additional blast furnace. The volume of new orders has fallen away lately, as many consumers have bought heavily as far as the end of the year. The approach of the Whitsuntide holiday has also had its effect upon the market. There has been no change in quotations. The fixed home prices of the standard No. 3 Cleveland G.M.B. foundry grade are 67s. 6d. per ton delivered in the Middlesbrough area, 69s. 6d. delivered elsewhere on the North-East Coast, 67s. 3d. delivered Falkirk and 70s. 3d. per ton delivered Glasgow.

There has been no relaxation of the demand for East Coast hematite. A number of large contracts have been made to the end of September, and consumers are willing to go even further, their apprehensions having been aroused by the scarcity of coke, which threatens to affect hematite values. So far there has been no departure from the fixed home quotations. The basis price of No. 1 East Coast hematite is 68s. per ton delivered Middlesbrough, graded differences being applied for delivery to other areas.

LANCASHIRE.—Reports from Midland ironmasters indicate that the consumption of foundry iron in Lancashire is steadily moving upwards. Welcome indications of the return of better conditions are also to be seen at one or two Manchester machine-tool making establishments, at several textile machinists and at heavy electrical-engineering works. Altogether, the outlook is by no means unsatisfactory, and it is expected that a fresh buying movement will be experienced before long. In the meantime, there has been no alteration in the price position. Offers of Derbyshire, Staffordshire and Cleveland brands of No. 3 foundry iron for delivery to users in Lancashire are on the basis of 74s. per ton, with Widnes an exception at 72s. 6d.; Northants is maintained at 72s. 6d. Scottish iron is offered at 83s. per ton, for delivery Manchester or equal, but is not meeting with much business owing to the competition of the cheaper Indian product.

MIDLANDS.—The chief call for iron, as regards this area, continues to come from the light-castings trade, but a slight improvement has been noted at the general engineering foundries. The Northants ironmasters are reported to be sending out more pig than they make, and their stocks are down to the lowest level for some time past. There is also an improving call for Derbyshire iron, but substantial stocks are still in existence. The minimum Association prices applying to Birmingham and the Black Country stations remain unchanged at 67s. 6d. for No. 3 Northants and 71s. for Derbyshire, Staffordshire and Lincolnshire No. 3, which prices are subject to rebate to big buyers. Scottish No. 3, of which limited tonnages are consumed locally, is quoted at between 85s. and 87s. 6d., medium-phosphorus iron, for engineering works, at 70s. to 80s., and low-phosphorus 81s. to 85s. Special refined iron varies considerably, according to analysis and tonnage, quotations ranging from £5 15s. to £6 15s. delivered this area.

SCOTLAND.—The demand for Scottish foundry iron remains quiet, many of the engineering founders being still short of work. Prices are unaltered. Regular deliveries of Cleveland iron are being made to the Falkirk light-castings founders, who remain busy. Phosphoric iron of local make is also being delivered, to implement sales made of English Midland iron, by a special arrangement. For No. 3 Cleveland the current quotations are 67s. 3d. f.o.r. Falkirk and 70s. 3d. f.o.r. Glasgow. Sales have been made up to the end of the year.

Coke

The makers are refusing to grant any concessions in foundry-coke prices, and are not generally willing to book ahead beyond September. Current quotations in the South Staffordshire area are as follow:—Best Durham grades, 36s. 6d. to 40s. (other grades down to 34s.); Welsh coke, 36s. to 45s., according to analysis; Scottish low-ash coke, 41s.; delivered Birmingham and district.

Steel

Business continues active, although on the approach of the Whitsun holidays the usual decrease in the volume of trading is noticeable, states the official report of the London Iron and Steel Exchange. Latterly, there has been a slight improvement in the demand from overseas, but most of the business transacted has been with home users. The market for semi-finished steel is rather quiet, but works are busy and have sufficient orders in hand to keep them well employed for some time to come. Lately, there has been more competition from Continental sellers, although the amount of business which has gone abroad has not been much in excess of the quantity now regarded as normal. There is a strong demand for most descriptions of finished-steel materials, although there may be some decline from the high levels of the earlier months of this year. In this department a slight improvement in export business is noticeable, but home consumers are responsible for most of the orders reaching the works.

Scrap

There is an active demand for cast-iron scrap in the Cleveland market. Quotations are unchanged, but an early advance is anticipated in some quarters. In the Midlands the demand remains satisfactory and scrap prices are unchanged at 55s. for machinery metal, 50s. for good heavy and 47s. 6d. for clean light metal, all delivered works. In South Wales, business in good machinery scrap remains limited, and only small parcels are being sold at about 50s. to 52s. 6d. per ton. In the Scottish market, machinery scrap is quieter at about 56s. to 56s. 6d. per ton, ordinary cast iron, in pieces not exceeding 1 cwt., being sold at 53s. 6d.

Metals

Copper.—The standard-copper market has been firmer this week, but quotations have still an irregular tendency. Refined copper remains in fairly good demand in this country. Copper consumption on the Continent continues to be heavy. It is reported that the German ban on copper imports is to be lifted on May 21, when the demand from that direction should revive to a certain extent.

Daily quotations:—

Cash.—Thursday, £32 18s. 9d. to £33; Friday, £33 7s. 6d. to £33 8s. 9d.; Monday, £33 to £33 1s. 3d.; Tuesday, £32 16s. 3d. to £32 17s. 6d.; Wednesday, £32 12s. 6d. to £32 15s.

Three Months.—Thursday, £33 3s. 9d. to £33 5s.; Friday, £33 13s. 9d. to £33 15s.; Monday, £33 6s. 3d. to £33 7s. 6d.; Tuesday, £33 2s. 6d. to £33 3s. 9d.; Wednesday, £32 18s. 9d. to £33.

Tin.—Buyers of this metal have been adopting a very cautious attitude, and the volume of trading has been limited. The market generally was inclined to await the outcome of the meeting of the International Tin Committee which took place yesterday. The result of the meeting, which was to deal with the question of a "buffer pool," was not known at the time of writing. Consumption of tin remains heavy in the United States, where industry has attained a good rate of activity under the stimulus of Government spending.

Market prices:—

Cash.—Thursday, £236 10s. to £236 12s. 6d.; Friday, £236 to £236 5s.; Monday, £233 5s. to £234; Tuesday, £232 10s. to £232 15s.; Wednesday, £232 5s. to £232 15s.

Three Months.—Thursday, £232 15s. to £233; Friday, £232 10s. to £232 15s.; Monday, £229 15s. to £229 17s. 6d.; Tuesday, £228 15s. to £229; Wednesday, £228 15s. to £229.

Spelter.—The International Zinc Cartel statistics for April (covering practically all producers except the United States) were distinctly favourable, showing as they did a reduction in stocks of over 10,000 tons, from 118,548 tons to 108,295 tons. Nevertheless, the market has adopted a hesitant tone, as a result of the rumours that the Cartel may not be renewed after July. It is true that there is some disagreement between certain members, but it is regarded as extremely unlikely that the organisation will be dissolved.

Day-by-day prices:—

Ordinary.—Thursday, £14 15s.; Friday, £14 15s.; Monday, £14 12s. 6d.; Tuesday, £14 10s.; Wednesday, £14 12s. 6d.

Lead.—Market conditions as regards lead are largely unchanged. The trade demand in this country remains good, and it is reported that deliveries of lead pipe and sheets in this country recently have averaged over 11,000 tons per month. Cable manufacturers, however, are still generally short of work.

Market fluctuations:—

Soft Foreign (Prompt).—Thursday, £10 18s. 9d.; Friday, £11; Monday, £10 17s. 6d.; Tuesday, £10 16s. 3d.; Wednesday, £11.

Iron and Steel Output in April

The British Iron and Steel Federation states that there were 98 furnaces in blast at the end of April, an increase of three since the beginning of the month. Production of pig-iron in April amounted to 496,300 tons, compared with 503,600 tons in March and 324,700 tons in April, 1933. The production includes 131,500 tons of hematite, 243,200 tons of basic, 98,200 tons of foundry, and 9,800 tons of forge pig-iron. The output of steel ingots and castings amounted to 716,800 tons, compared with 829,700 tons in March and 510,300 tons in April, 1933.

NICKEL has been reduced in price and now ranges from £200 to £205 per ton. Nickel sulphate is unchanged, but the price of "F" nickel shot has been reduced to £180 per ton.

CAST IRON FLANGED PIPES
2 in.—12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

ARMSTRONG WHITWORTH
Pneumatic Tools

With
HIGH PERFORMANCE
LOW AIR CONSUMPTION
And at a
MODERATE
PRICE

KL
Kryn & Lahy (1928) Ltd
Engineers & Steel Founders
INCORPORATING THE CAMPBELL GAS ENGINE CO. LTD.
COBORN WORKS
LETCHWORTH
HERTS

ON ADMIRALTY, WAR OFFICE COLONIAL AND ALL LISTS
TELEGRAMS KRYNLAHY, LETCHWORTH
CABLES - CANGAS
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CYRIL COHEN
J. DESCHAMPS
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M.I.MECH.E., M.I.M.A.
C. B. UNWIN, B.SC. (ENG.) LOND., ASSOC. M.INST.C.E.

OUR REF.
YOUR REF
DATE

JD/RLK

8th January 1934.

Messrs Sir W.G.Armstrong Whitworth & Co (Engineers) Ltd.
Scotswood Works,
Newcastle on Tyne.....

Dear Sirs,

We have pleasure in informing you that we are completely satisfied with the performance of the pneumatic chipping hammers which we have obtained from you these last few months.

We have now 65 of these hammers at work in our Fettling Shop, having standardised on your tools and we find their cutting power equal, if not better, to that of the hammers we used previously. The air consumption is remaining within narrow limits as good as it was when the hammers were new.

We particularly appreciate the service which your firm is giving us in arranging for periodical visits of your engineer and the fact that you are not charging us excessive prices for whatever spare parts we require.

You are quite at liberty to make use of this testimonial if you elect to do so.

Yours faithfully,
KRYN & LAHY (1928) LIMITED

Joint Managing Director.

EFFICIENT
AFTER SALES
SERVICE.

ARMSTRONG SCOTSWOOD WORKS — SIR W.G. ARMSTRONG WHITWORTH & Co. (ENGINEERS) LIMITED — WHITWORTH NEWCASTLE UPON TYNE

Telephone: Newcastle 34201. *Grams: Armstrongs, Newcastle-on-Tyne.*

RAW MATERIALS—PRICE LIST

(Wednesday, May 16, 1934)

COPPER

	£ s. d.
Standard cash	32 12 6
Three months	32 18 9
Electrolytic	36 0 0
Tough	34 15 0
Best selected	35 5 0
Sheets	62 0 0
India	44 10 0
Wire bars	36 5 0
Ingot bars	36 5 0
H.C. wire rods	38 10 0
Off. av. cash, April	33 10 10½
Do., 3 mths., April	33 5 8½
Do., Sttlmnt., April	33 0 10½
Do., Electro, April	36 5 9
Do., B.S., April	36 3 1½
Do., wire bars, April	36 10 9
Solid drawn tubes	10d.
Brazed tubes	10d.
Wire	6½d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8½d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7½d.
Rolled metal	7d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN

Standard cash	232 5 0
Three months	228 15 0
English	233 0 0
Bars	234 10 0
Straits (nom.)	233 15 0
Australian (nom.)	233 10 0
Eastern	230 5 0
Banca (nom.)	234 0 0
Off. av. cash, April	239 6 0
Do., 3 mths., April	237 13 8½
Do., Sttlmt., April	239 6 3

SPELTER

Ordinary	14 12 6
Remelted	14 15 0
Hard	12 0 0
Electro 99.9	17 5 0
English	15 2 6
India	14 0 0
Zinc dust	17 0 0
Zinc ashes	3 5 0
Off. aver., April	15 1 1⅞
Aver. spot, April	14 18 3¾

LEAD

Soft foreign ppt.	11 0 0
Empire	11 10 0
English	12 5 0
Off. average, April	11 12 11¼
Average spot, April	11 10 0

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

Zinc sheets, English	23 10 0
Do., V.M. ex whse.	23 0 0
Rods	29 0 0

ANTIMONY

English	42 0 0 to 43 0 0
Chinese, ex-whse.	36 0 0
Crude	25 0 0

QUICKSILVER

Quicksilver 10 10 0 to 10 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	8 17 6
45/50%	13 0 0
75%	18 2 6
Ferro-vanadium—	
35 50%	12/8 lb. Va.
Ferro-molybdenum— 70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium— 23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten— 80/85%	3/- lb.
Tungsten metal powder— 98/99%	3/3 lb.
Ferro-chrome— 2/4% car.	32 0 0
4/6% car.	23 0 0
6/8% car.	21 12 6
8/10% car.	21 12 6
Ferro-chrome— Max. 2% car.	37 10 0
Max. 1% car.	38 15 0
Max. 0.70% car.	42 0 0
70% carbon-free	10½d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£180 0 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium— 96/98%	2/5 lb.
Ferro-manganese (net)— 76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese— 94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras— Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	2 13 6	to 2 15 0
Bundled steel and shrngs.		2 7 6
Mixed iron and steel		2 10 0
Heavy cast iron	2 7 0	to 2 8 0
Good machinery	2 10 0	to 2 12 6
Cleveland—		
Heavy steel		2 10 0
Steel turnings		1 17 6
Cast-iron borings		1 7 6
Heavy forge		2 10 0
W.I. piling scrap		2 5 0
Cast-iron scrap	2 10 0	to 2 13 0
Midlands—		
Light cast-iron scrap		2 7 6
Heavy wrought iron		3 0 0
Steel turnings, f.o.r.		1 13 0
Scotland—		
Heavy steel	2 10 0	to 2 11 3
Ordinary cast iron		2 13 6
Engineers' turnings		2 0 0
Cast-iron borings	2 0 0	to 2 1 6
Wrought-iron piling		2 11 3
Heavy machinery	2 16 0	to 2 16 6

London—Merchants' buying prices, delivered yard.

Copper (clean)	27 0 0
Brass	19 10 0
Lead (less usual draft)	10 0 0
Tea lead	7 10 0
Zinc	9 10 0
New aluminium cuttings	70 0 0
Braziery copper	24 0 0
Gunmetal	25 0 0
Hollow pewter	155 0 0
Shaped black pewter	110 0 0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/-
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	80/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	83/-
Clyde, No. 3	83/-
Monkland, No. 3	83/-
Summerlee, No. 3	83/-
Eglinton, No. 3	83/-
Gartsherrie, No. 3	83/-
Shotts, No. 3	83/-

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

	£ s. d.	£ s. d.
Iron—		
Bars (cr.)	9 12 6	to 9 15 0
Nut and bolt iron	7 5 0	to 8 0 0
Hoops	10 10 0	to 12 0 0
Marked bars (Staffs) f.o.t.	12 0 0	
Gas strip	10 10 0	to 12 0 0
Bolts and nuts, ¾ in. × 4 in.	13 15 0	
Steel—		
Plates, ship, etc.	8 15 0	to 8 17 6
Boiler plts.	8 2 6	to 8 10 0
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5½ in.		9 7 6
Rounds under 3 in. to ⅜ in. (Untested)		8 12 0
Flats—8 in. wide and over		8 12 6
,, under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0	to 8 10 0
Fishplates	12 5 0	to 12 10 0
Hoops (Staffs)		—
Black sheets, 24g. (4-t. lots)		10 10 0
Galv. cor. shts. (,,)		13 0 0
Galv. flat shts. (,,)		13 10 0
Galv. fencing wire, 8g. plain		14 10 0
Billets, soft		5 10 0
Billets, hard	6 17 6	to 7 2 6
Sheet bars	5 0 0	to 5 5 0
Tin bars		5 0 0

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round— to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	13.50
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	29.00
Sheet bars	30.00
Wire rods	38.00
	Cents.
Iron bars, Phila.	1.94
Steel bars	1.90
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.25
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 27/6
,, furnace	20/-
Durham foundry	21/- to 25/-
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	17/- to 17/6
,,	28×20 ,,	34/- to 35/-
,,	20×10 ,,	24/3 to 24/6
,,	18¾×14 ,,	17/9 to 18/-
C.W.	20×14 ,,	15/- to 15/6
,,	28×20 ,,	31/6 to 33/-
,,	20×10 ,,	21/9 to 22/-
,,	18¾×14 ,,	15/6 to 16/-

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6 0 0 to £7 0 0
Bars-hammered, basis	£16 0 0 to £16 10 0
Bars and nail-rods, rolled, basis	£15 15 0 to £16 0 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£30 0 0 to £31 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.	
May	10 ..	32	18	9	No change .
,,	11 ..	33	7	6	inc. 8/9
,,	14 ..	33	0	0	dec. 7/6
,,	15 ..	32	16	3	,, 3/9
,,	16 ..	32	12	6	,, 3/9

Electrolytic Copper

		£	s.	d.	
May	10 ..	36	0	0	inc. 15/-
,,	11 ..	36	10	0	,, 10/-
,,	14 ..	36	0	0	dec. 10/-
,,	15 ..	36	0	0	No change
,,	16 ..	36	0	0	,, ,,

Standard Tin (cash)

		£	s.	d.	
May	10 ..	236	10	0	inc. 15/-
,,	11 ..	236	0	0	dec. 10/-
,,	14 ..	233	5	0	,, 55/-
,,	15 ..	232	10	0	,, 15/-
,,	16 ..	232	5	0	,, 5/-

Tin (English ingots)

		£	s.	d.	
May	10 ..	237	0	0	inc. 15/-
,,	11 ..	236	15	0	dec. 5/-
,,	14 ..	234	0	0	,, 55/-
,,	15 ..	233	0	0	,, 20/-
,,	16 ..	233	0	0	No change

Spelter (ordinary)

		£	s.	d.	
May	10 ..	14	15	0	dec. 3/9
,,	11 ..	14	15	0	No change
,,	14 ..	14	12	6	dec. 2/6
,,	15 ..	14	10	0	,, 2/6
,,	16 ..	14	12	6	inc. 2/6

Spelter (Electro, 99.9 per cent.)

		£	s.	d.	
May	10 ..	17	8	9	dec. 3/9
,,	11 ..	17	8	9	No change
,,	14 ..	17	6	3	dec. 2/6
,,	15 ..	17	5	0	,, 1/3
,,	16 ..	17	5	0	No change

Zinc Sheets (English)

		£	s.	d.	
May	10 ..	23	10	0	No change
,,	11 ..	23	10	0	,, ,,
,,	14 ..	23	10	0	,, ,,
,,	15 ..	23	10	0	,, ,,
,,	16 ..	23	10	0	,, ,,

Lead (English)

		£	s.	d.	
May	10 ..	12	5	0	dec. 5/-
,,	11 ..	12	5	0	No change
,,	14 ..	12	5	0	,, ,,
,,	15 ..	12	5	0	,, ,,
,,	16 ..	12	5	0	,, ,,

Imports and Exports of Pig-Iron, Iron and Steel Castings, etc., in April and the four months, 1934, compared with a year ago.

	April.		Four months.		April.		Four months.	
	1933.	1934.	1933.	1934.	1933.	1934.	1933.	1934.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Imports.								
Pig-iron, forge	—	—	—	—	—	—	—	—
,, foundry	4,148	4,328	13,668	12,764	13,184	12,417	44,958	36,418
,, acid	—	—	37	—	—	—	226	—
,, basic	4,200	5,171	12,331	19,916	11,200	13,843	33,065	53,088
Total (including other kinds)	8,348	10,402	26,036	37,928	24,384	31,628	78,249	120,485
Castings and forgings	39	496	359	1,025	871	10,663	8,509	24,431
Cast pipes and fittings	212	81	466	475	3,454	4,153	9,058	26,393
Stoves, grates, etc.	42	76	214	272	5,623	7,667	22,083	26,886
Baths	296	776	1,292	2,731	7,150	18,161	30,142	64,746
Hollow-ware, all kinds	125	192	620	806	7,438	12,134	27,654	44,242
Exports.								
Pig-iron, forge	207	113	728	362	777	472	2,892	1,490
,, foundry	3,807	6,781	13,268	22,490	12,550	20,625	46,565	75,354
,, acid	3,115	6,877	14,198	15,601	9,339	22,018	43,074	49,347
,, basic	10	100	745	665	35	326	2,975	2,146
Total	7,139	13,871	28,939	39,118	22,701	43,441	95,506	128,337
Castings and forgings	224	645	817	1,719	8,385	20,975	34,307	63,881
Cast pipes and fittings, up to 6 in. diameter	3,860	6,399	14,710	19,455	40,852	65,049	162,182	215,544
,, ,, ,, over 6 in. ,,	1,042	3,769	8,855	14,657	7,634	28,033	63,424	107,649
Stoves, grates, etc.	557	696	2,004	2,806	24,120	31,121	90,993	133,160
Sanitary cisterns	184	226	774	940	5,876	6,834	23,180	27,274
Bedsteads, ine. tubes therefor	323	442	1,363	1,751	11,368	14,883	51,778	57,884
Cast hollow-ware	314	281	1,332	1,139	12,471	10,299	53,868	42,331

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